VOL. 174 NO. 5 AMERICAN MAY, 1951

JUN -1 1951

Gas Journal

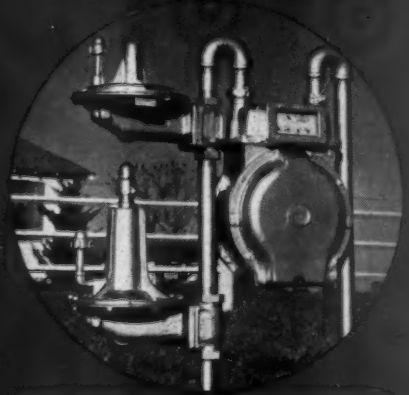
REYNOLDS REGULATORS

ACCURATE

EFFICIENT

DURABLE

Plus a Greater Safety Factor



Dual Controls insure efficient—safe regulation on pressures too high to handle with one regulator. For very high pressure of 1,000 lbs., Reynolds make a tripple reduction. This natural gas line is in the southwest.

Reynolds Regulators have been first-in-the-field for more than half a century. They have risen to leadership in the gas control field because they have combined the correct factor of safety with each line of regulators simply operated and of proven superiority. Engineers have come to demand Reynolds Regulators . . . It's safe to specify Reynolds Regulators . . . They reassure safety . . . Insure efficiency in Gas Control.

REYNOLDS GAS REGULATOR CO.

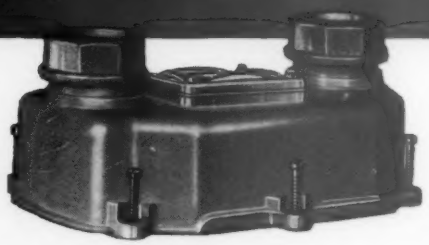
ANDERSON, INDIANA, U.S.A.

RECOGNIZED GAS CONTROL SINCE 1892 . . . . . .

YOUR OLD FAVORITE . . .

No. 0 Gas meter

NOW BETTER THAN EVER!



BETTER MATERIALS—The outer housing is made of strong aluminum alloy pressure castings. Steel spud inserts prevent threads from galling and give extra reinforcement to the cover. A hand hole plate in the cover permits external adjustment of the tangent.

EASIER TO HANDLE—The improved Rockwell No. 0 meter is lighter and easier to handle. That's because of the aluminum alloy body and cover. Actual weight is only 18 pounds—less than one-half that of any cast iron meter. This lighter weight saves effort on the part of those handling meters. It saves important dollars in transportation costs.

NEW SERVICE EASE—This meter has been designed with the meter repairman in mind. It can be quickly dismantled and reassembled. All parts are readily accessible. By following charted Rockwell procedures, replacements and adjustments can be made by even the inexperienced workman using standard tools.

IMPROVED PERFORMANCE—There are fewer parts in this new No. 0 meter, sixty per cent less soldered joints, a fool-proof tangent location—all of which contribute to a longer life of dependable meter performance with the highest degree of sustained accuracy.

WRITE FOR BULLETIN NO. 1100

All improvements to the working mechanism can be incorporated into Rockwell-Emco meters of previous manufacture.

ROCKWELL

MANUFACTURING COMPANY

PITTSBURGH 8, PA.

Atlanta Boston Chicago Columbus Houston Kansas City
Los Angeles New York Pittsburgh San Francisco Seattle Tulsa

JUN -1 1951
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everything

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SERIAL RECORD
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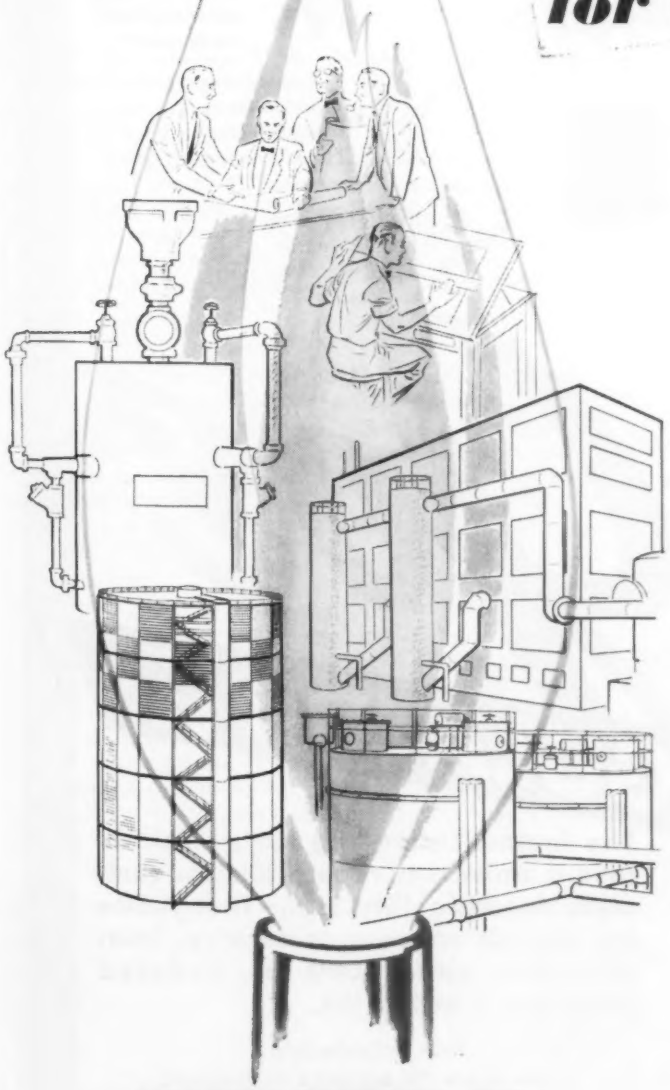
for the Gas Industry



Koppers Company offers a unified service comprising consultation, design, manufacturing, construction and maintenance—all now coordinated under the direction of the company's Engineering and Construction Division.

- Economic Surveys
- Planning
- Engineering
- Construction
- Plant Evaluation
- Reports
- Operation

- Mixed Gas Installations
- Liquid Petroleum Plants
- Carbureted Water Gas
- Gas Producers
- Liquid Purification
- Waterless Holders
- Water Seal Holders
- Precipitators
- Condensers
- Hydrocarbon Reforming Furnaces
- Oil Gas Sets (High Btu)
- Blue Gas Sets
- High-Pressure Boilers
- Dry Purification
- Compressor Stations
- Scrubbers (Light oil, Gum, Naphthalene)

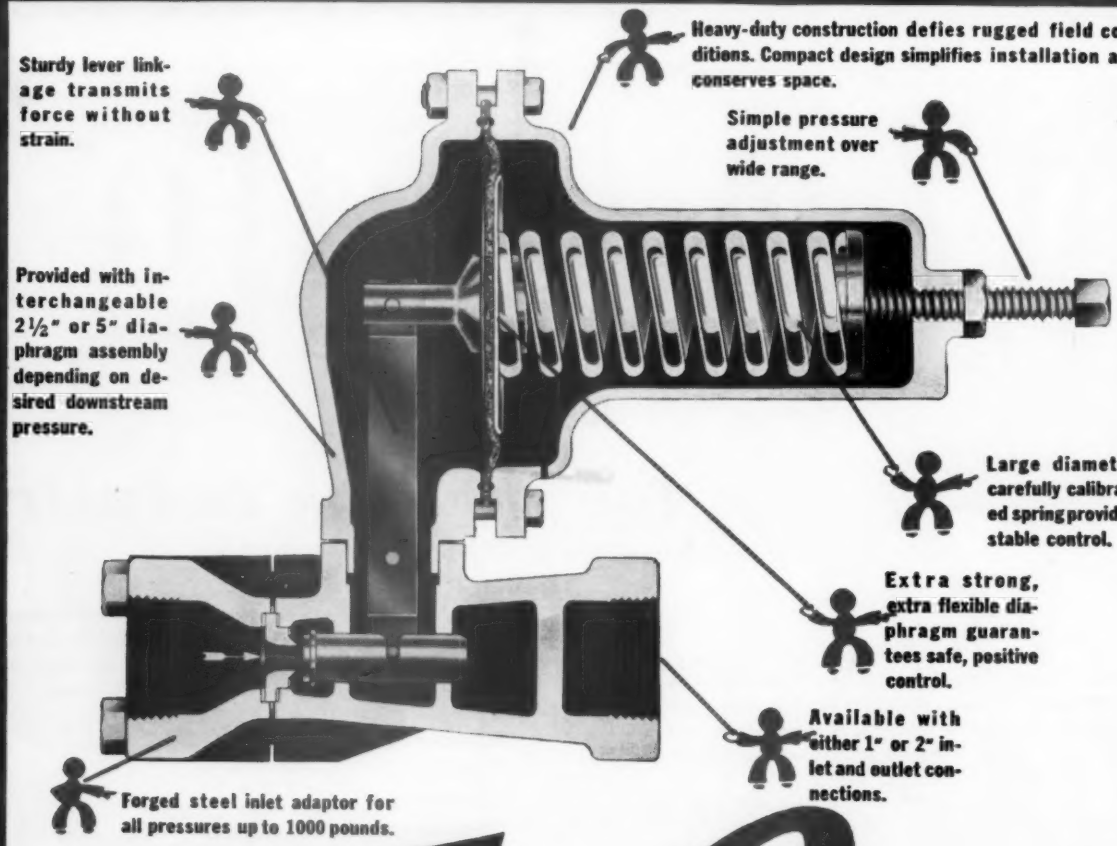
- Natural Gas Conversions
- Oil Fogging
- Pipe Lines
- Synthesis Gas

On any of your conversion or production problems, the Engineering Staff of our Gas Department will be glad to work with you. Call, write or wire.

KOPPERS COMPANY, INC.
Engineering and Construction Division
Pittsburgh 19, Pa.

KOPPERS

AMERICAN GAS JOURNAL, May, 1951. Vol. 174, No. 5. Published monthly by American Gas Journal, at 73 Main Street, Brattleboro, Vt. Executive and Editorial offices at 205 East 42nd Street, New York 17, N. Y. Subscription prices: United States $3.00 per year; Canada $4.00; foreign $10.00; single copies 50 cents. Entered as second class matter January 24, 1950, at post office at Brattleboro, Vermont, under Act of March 3, 1879. Printed in U.S.A.



Heavy-duty construction defies rugged field conditions. Compact design simplifies installation and conserves space.

Sturdy lever linkage transmits force without strain.

Simple pressure adjustment over wide range.

Provided with interchangeable 2½" or 5" diaphragm assembly depending on desired downstream pressure.

Large diameter carefully calibrated spring provides stable control.

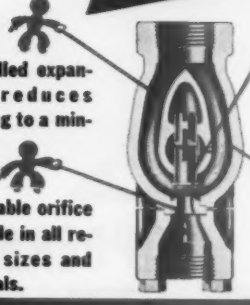
Extra strong, extra flexible diaphragm guarantees safe, positive control.

Available with either 1" or 2" inlet and outlet connections.

Forged steel inlet adaptor for all pressures up to 1000 pounds.

FISHER® Big Joe

FIELD REGULATOR TYPE 630



Controlled expansion reduces freezing to a minimum.

Removable orifice available in all required sizes and materials.

Removable disc holder assembly. Disc of synthetic rubber or special Teflon as required.

Streamlined travel ways eliminate reverse flow and increase capacity.

The famous Fisher "Big Joe", which enjoys a universal reputation for complete dependability, is the first choice for pounds to pounds service. Inlet pressures up to 1000 lbs. Reduced pressures 5 to 200 lbs.

Write for Catalog P-10

FISHER LEADS THE INDUSTRY IN RESEARCH FOR BETTER GAS PRESSURE CONTROL

FISHER GOVERNOR COMPANY

Marshalltown, Iowa

AMERICAN Gas Journal
ESTABLISHED 1859

VOLUME 174 | MAY 1951 | NUMBER 5

This month...

A headline in Southern Counties (Los Angeles) *News* announces the winners of a Giant Baking Contest. As we read it Giant keeps coming up as a noun. Pie Baking . . . Cake Baking . . . Giant. . . . Reminds us of a recipe we once read, "How to Saute a Moose." In any event, a Gargantuan undertaking.

• • •

Always admirers of the Grand Gesture, we view with a mixture of admiration and awe the way our government throws around that tax money we mailed in before midnight on March 15. Just received, a 37 word telegram from the US Army Quartermaster, right in New York City, request, a "firm unit price quotation on one subscription renewal to AMERICAN GAS JOURNAL." Our reply, to be dispatched by carrier pigeon if possible, will merely say $3.00 a year: same as last year; same as the year before that.

• • •

Just to save an honest penny on postage, we will formally announce here that the *American Gas Handbook* will go out free to all JOURNAL subscribers in good standing as of June. A recent promotion letter seems to have created the impression that only new subscribers will get the *Handbook*. That, we would regard as very shabby treatment indeed for old and loyal readers.

• • •

A modest but bright new star in the publishing firmament is *Blue Flame Dealer News*, just originated by Portland (Oregon) Gas and Coke Co. Of course it is pointed toward making better gas appliance merchandisers out of the Portland dealers; tells of the gas companies advertising campaigns; announces a contest for the Spring Festival of Gas Ranges. All in all a very good job, and something that should give gas a needed lift in an area where the electrical competition is little less than brutal.

Contents

Editorial .. 17

This is Dallas and Lone Star Gas .. 18

57 New England Gas Properties Tell Plans for Use of Natural Gas .. 19

New England Is Urged to Explore Possibilities of Uniform Gas—Frederic O. Hess .. 22

Summary of HiBtu Oil Gas Progress Shows Wide Adaptability Achieved—Edwin L. Hall .. 23

Accurate Temperature Forecasting Helps in Gas Operations—William J. Hartnett .. 27

American Gas Fundamentals: Methods of Storing Gas .. 31

Gas Radiant Heaters Revive Interest in Thermal Cracking—Kurt W. Fleisher .. 35

Guide Covering Changeover Practices Summarizes Experiences—J. V. Turpish, K. J. Burnett, D. L. Drake .. 38

Index of Yields: Selected Utilities Stocks .. 42

News of the Gas Industry .. 44

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Arthur Rohman · Western Editor **John F. Falvey · Financial Editor**

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"For Superiority in research, engineering, styling, safety and manufacture"

GARLAND LEADERSHIP is confirmed again!

The American Society of Industrial Engineers—an outstanding national authority—has officially endorsed the complete line of Garland cooking equipment for 1951! Garland was the first—and is still the only line of ranges—ever to achieve this top recognition!

It proves once more what Garland users have known for years! Garland is first in sales because Garland is first in dollar for dollar value! See your Garland Food Service Equipment Dealer!

DETROIT-MICHIGAN STOVE CO.

Detroit 31, Michigan • Fine Ranges Since 1864

All Garland units are available in Stainless Steel and equipped for use with manufactured, natural or L-P gases.

THE TREND IS TO GAS FOR ALL COMMERCIAL COOKING

RESTAURANT RANGE
No. 83

DINETTE RANGE

ALL HOT TOP
OPEN TOP • FRY TOP
DEEP FAT FRYER • BROILER

GARLAND

Bryant BLUE SEAL...Gives users the water heater features they want

The Bryant *Blue Seal* Gas Water Heater is made to provide the advantages people want: Completely automatic operation . . . dependability . . . *plenty* of hot water . . . fast, easy temperature selection . . . cleanliness and economy . . . cathodic tank protection.

And beyond these purely operational features is *built-in* Bryant quality that makes for greater customer acceptance and satisfaction. From the extra-heavy tank to the gleaming, easy-to-clean jacket, the *Blue Seal* meets standards far higher than any existing requirements for gas water heater construction.

That's why Bryant *Blue Seal* Water Heaters are backed with greatest confidence by the Bryant 10-Year Protection Plan. That's why your customers ask for the Bryant *Blue Seal* . . . why you can count on gas economy and a minimum of service with this great water heater on your lines.

For complete details, contact the Bryant Distributor near you or write direct. Bryant Heater Division, Dept. 274, Affiliated Gas Equipment, Inc., 17825 St. Clair Ave., Cleveland 10, O.

Bryant Model 115 *Blue Seal* Automatic Gas Water Heater. Made in 20, 30, 40 and 50-gallon capacities. Features Grayson *Unitrol* with 100% Safety Pilot; extra-thick *Fiberglas* insulation; exclusive *Link-Trap* segmental baffle; exclusive streamlined downdraft diverter; sturdy one-piece steel base; exclusive porcelain-enameled aeration plate; cast iron burner with raised, drilled ports; and the *Protect-O-Rod*, magnesium alloy anode which inhibits rust, adds *years* to life of tank.

Let the pup be furnace man ...and water boy too!

bryant

AUTOMATIC HEATING

Your *single* source of supply for everything in gas heating equipment!

The STRENGTHS you need

The strengths demanded of pipe to be laid under expensive modern pavements, if costly repairs and replacements are to be avoided, are known strengths—proved by experience and determinable by tests. The four strength factors that pipe must have to withstand beam stresses, external loads, traffic shocks and abnormal working pressures are listed on the opposite page. *No pipe, deficient in any of these strength factors, should ever be laid in paved streets of cities, towns or villages!* Cast iron water and gas mains, laid over a century ago, are serving today in the streets of 30 or more cities. These service records prove that cast iron pipe not only resists corrosion but has all the vital strength factors of long life and economy.

CAST IRON PIPE

in pipe for city streets...

No pipe that is deficient in any of the following strength factors should ever be laid under paved streets.

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

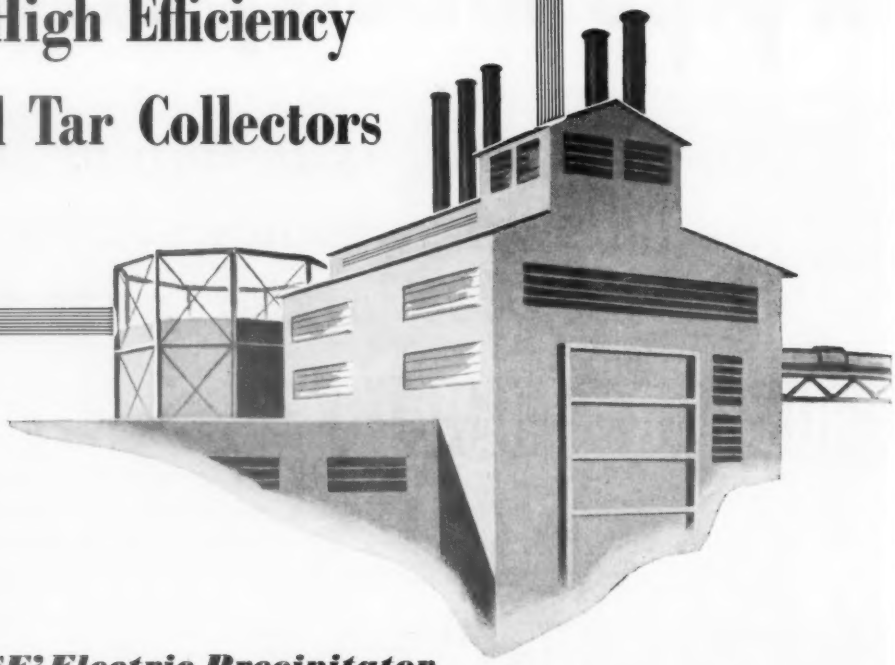
BURSTING STRENGTH

In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

CAST IRON PIPE RESEARCH ASSOCIATION, THOS. F. WOLFE, MANAGING DIRECTOR, 122 SO. MICHIGAN AVE., CHICAGO 3.

SERVES FOR CENTURIES

BUELL High Efficiency Dust and Tar Collectors



Buell 'SF' Electric Precipitator

with its exclusive operating advantages is ideal for the collection of ultra-fine dusts and for the extraction of tars from manufactured gas.

Buell van Tongeren Cyclones

can be used in single or multiple units to handle any gas volume from 300 c.f.m. and up to temperatures of 1500°F. Buell large diameter cyclones do not clog, reduce maintenance to a minimum, and can be used advantageously on gas for waste heat boilers in water gas generation.

Buell 'Breeze' Collector

for Water Gas Sets offers special advantages: no moving parts, no floor space required—easily installed in existing plants, no additional flare-back, no back pressure on superheaters, and no fans or motors.

For more information as to your particular problem, contact
MULCARE ENGINEERING CO., INC. 55 Park Place, New York 7, N. Y.
Sole Representative in the Gas Industry for the Buell Engineering Company.

ELECTRIC CYCLONIC

buell

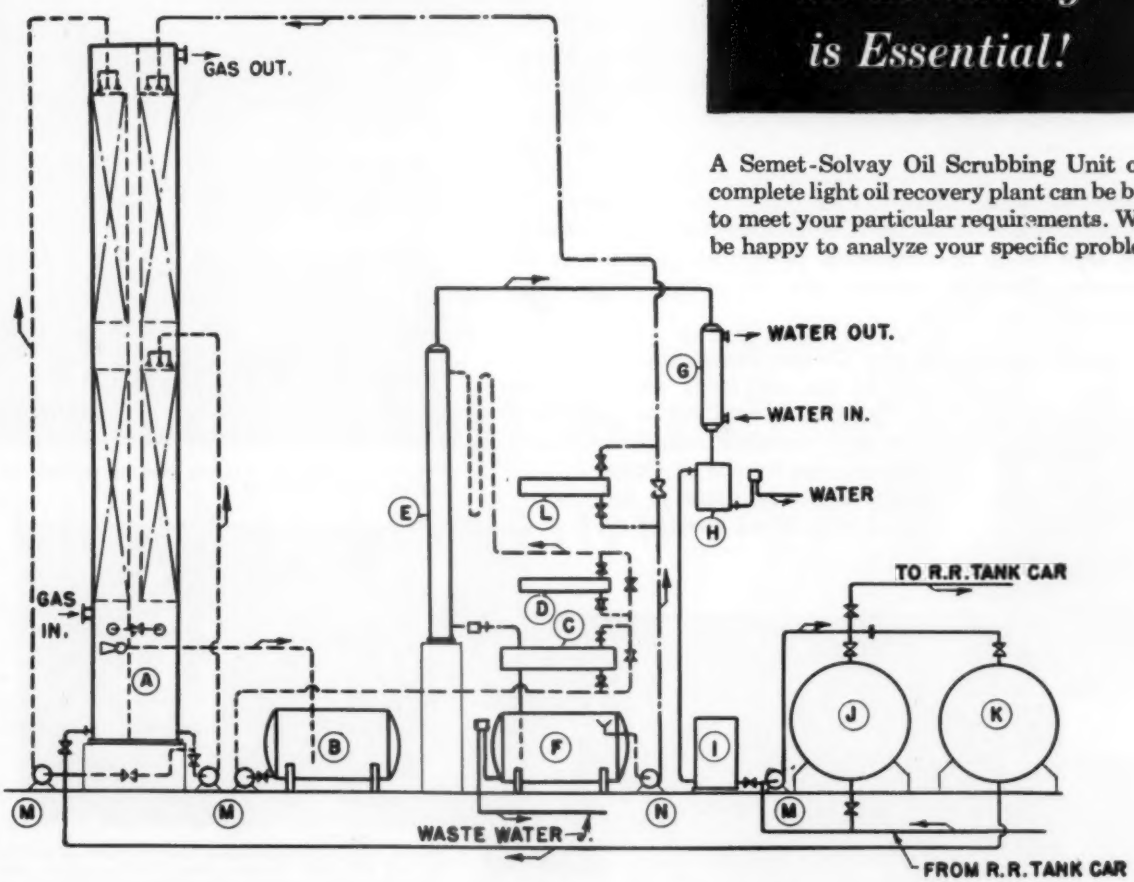
Engineered Efficiency in **Dust Recovery**

For the successful use of HIGH BTU OIL GAS...

Gas Conditioning is a Must! Oil Scrubbing is Essential!

Light oils are valuable. They can be recovered if profitable.

A Semet-Solvay Oil Scrubbing Unit or a complete light oil recovery plant can be built to meet your particular requirements. We'll be happy to analyze your specific problem.

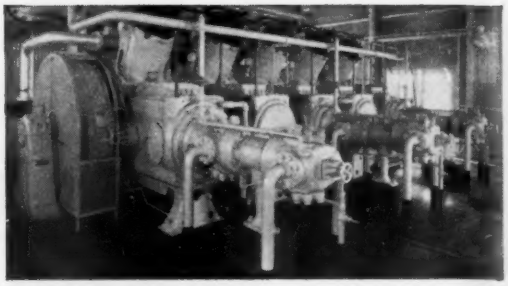


LEGEND

A—Scrubber
B—Enriched Oil Pump Tank
C—Oil to Oil Heat Exchanger
D—Oil Heater
E—Still
F—Stripped Oil Pump Tank
G—Product Condenser
H—Product Decanter
I—Product Receiver
J—Product Storage Tank
K—Absorption Oil Storage Tank
L—Oil Cooler
M—Absorption Oil Circ. Pump
N—Stripped Oil Circ. Pump

At Sun Oil's Starr County Plant . . .

A 4-WAY JOB FOR MODERN COOPER-BESSEMERS



This 10-cylinder, 1100 hp GMV Turboflow compressor, known for extreme compactness and over-all operating economy, compresses residue gas from 1,000 to 2500 psi for return to field reservoir. Automatic control maintains constant pre-set discharge pressure.

This line-up of Cooper-Bessemer gas engines in generating plant consists of four 600 hp, 8-cylinder JS's driving Ideal 400 kw generators and three 280 hp, 5-cylinder Type GS engines driving Ideal 200 kw generators.

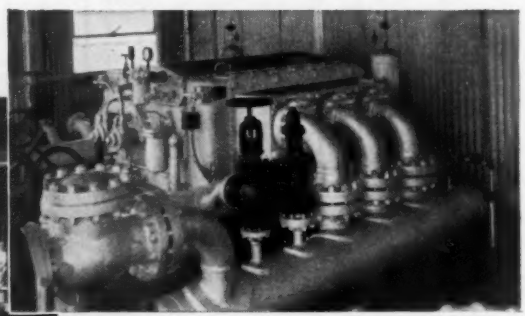
Exterior of generator building showing muffler, air filter and oil cooler equipment.

In this new natural gasoline plant, engineered by Petroleum Engineering, Inc., there's good evidence of how well, how efficiently Cooper-Bessemer units of various types meet today's needs in power, compressing and pumping.

For in this one modern project, as shown here, you'll find Cooper-Bessemer in-line gas engines driving generators for all electric power requirements. And you'll find space-saving Cooper-Bessemer Twin-line pumps handling lean oil. These pumps in turn are direct-driven by compact Cooper-Bessemer GMX V-Type gas engines. Finally, last but not least, a 1,100 hp Cooper-Bessemer GMV Turboflow, tops today in compressor compactness and over-all economy, handles residue gas for return to a field reservoir.

To get at the reason *why* Cooper-Bessemers have been picked for all these services, you have only to weigh the important *new* developments introduced during recent years by one of America's *oldest* builders of engines and allied machinery.

Another Example of Efficient Power at Lower Cost



One of two Cooper-Bessemer Twin-line lean oil pumps in Sun Oil Starr County plant. High pressure side (foreground) is designed to operate on 41 API gravity lean oil, from 220 to 1100 psi while handling 248 gpm. Other side, in series, operates from 20 to 225 psi while handling 388 gpm.

Two Cooper-Bessemer GMX-4, V-Type gas engines, each direct-driving a Twin-line 6-cylinder lean oil pump through fire wall. Each GMX is rated 200 hp at 400 rpm.

The Cooper-Bessemer Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York City Washington, D. C. Bradford, Pa. Parkersburg, W. Va. San Francisco, Calif. Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle, Wash. Tulsa, Okla. Shreveport, La. St. Louis, Mo. Los Angeles, Calif. Caracas, Venezuela Gloucester, Mass. Calmes Engineering Co., New Orleans, La.

A NATURAL . . . for Natural Gas!

VULCAN DIAPHRAGMS

If you're shifting to natural gas distribution, remember that VULCAN DIAPHRAGMS in meters, regulators and governors are right at home.

VULCAN DIAPHRAGMS operate with high efficiency in natural gas. They do not dry out and stiffen because they contain no oils or dressings.

VULCAN DIAPHRAGMS save you the periodic expense of oiling. They keep your meter shop clean. They are not messy to handle.

Try time-tested VULCAN DIAPHRAGMS. See what an improvement they are over old-time methods.

VULCAN RUBBER PRODUCTS MADE IN BROOKLYN, N.Y. BY VULCAN RUBBER PRODUCTS, INC.

VULCAN

RUBBER PRODUCTS, INC.

(Formerly Vulcan Proofing Company)

First Avenue & 58th Street, Brooklyn 20, N. Y.

You can turn LOOKERS into BUYERS with the new SERVEL

HERE's Servel's new Royal Tudor . . . shortest route to your customer's checkbook. Packed with more of everything housewives want in a refrigerator, it's a competition stopper. Good looks, huge capacity and Servel dependability make it admired and wanted . . . make it sell!

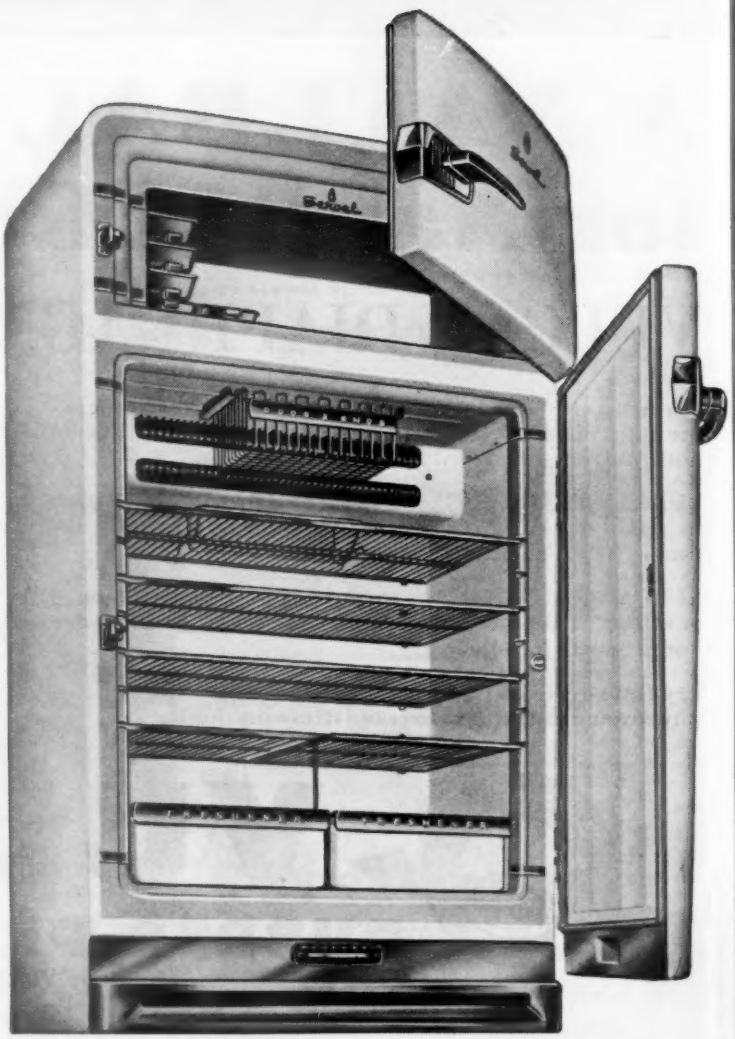
This handsome aristocrat of the new Servel line is much roomier inside, yet requires no extra kitchen space. It offers a wealth of sales-winning new features including the giant full-width evaporator with exterior door . . . glass-covered Dew-Action Vegetable Fresheners . . . 5 "Quick-Release" Ice-Cube Trays. And, of course, there's Servel's marvelous, motorless freezing system—famous through the years for silent dependable refrigeration.

So give prominent display space to the Royal Tudor and all seven other sensational new Servels. Every one is newly designed . . . engineered to attract prospects and clinch sales for you. For full details write Servel, Inc., Dept. J-15, Evansville 20, Ind.

STAYS SILENT . . . LASTS LONGER

Servel

The GAS Refrigerator



ROYAL TUDOR (Model BR-1118)—Volume, 11.5 cu. ft. 2 glass-covered Dew-Action Vegetable Fresheners. "Odds and Ends" Basket. 5 "Quick-Release" Ice-Cube Trays. Full-width evaporator with exterior door.

Less MAN-HOURS

More PRODUCTION TIME

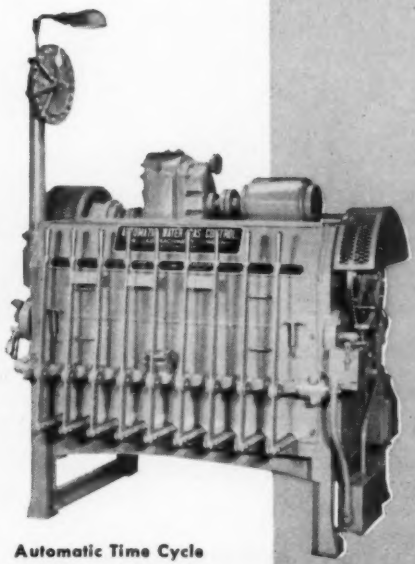
with equipment and services of The Gas Machinery Company

Oil Gas Generation will eliminate clinker labor . . . will produce more BTU's while relieving a critical manpower situation.

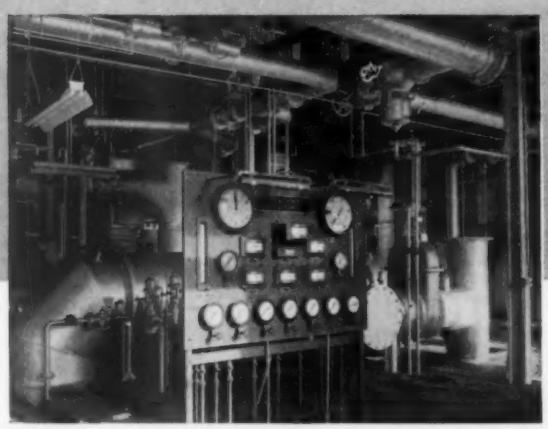
An Automatic Cycle Control will save fuel and improve the quality and productiveness of almost any existing gas generating apparatus.

Other Gasmaco equipment for catalytic reforming of hydrocarbons, modern water gas practice, gas conditioning and auxiliary services.

Gasmaco engineers are available for your design and operating problems.



Automatic Time Cycle and Thermal Control



Operating Floor, Four-Shell Regenerative Oil Gas Set

THE GAS MACHINERY COMPANY

16114 WATERLOO ROAD
CLEVELAND 10, OHIO

Designers • Fabricators • Erectors
Gas Plant Equipment and Industrial Furnaces

THE GAS MACHINERY CO. (Canada) Ltd.
HAMILTON, ONTARIO

...why so many?
Gas . . . with all its proved as well
as many potential uses . . . needs the
additional large advantage: standardization.
Gas . . . needs its own "uniformity" definition,
in terms of Btu content and burning characteristics.
Gas . . . needs, vitally, service and performance reliability.

Here is a gas-fired ceramic kiln, producing high-quality glazed ware in standardized colors. The predetermined critical heating time-and-temperature, both under precise automatic control, directly determine the degree to which the standard colors are matched.

What happens when burning characteristics of gas change?

Time and temperature determinations are "out" . . . color is "out" . . . ware probably will be rejected . . . new time and temperature factors are determined and applied for the new burning characteristics. *But*—when will it change again?

What happens when gas is shut off, on "interruptible basis"?

NO PRODUCTION . . . lost income for that gas customer and his employees.

The economic, technical and production advantages of *standardization* were established in American industry . . . standard *dimensions*, *capacities* and *characteristics* are recognized and practiced in design and manufacture of equipment—installation, utilization and operation of equipment—maintenance and repair. Standardization is taken-for-granted in our production-line economy . . . *"Standardized gas" is wanted, practical, economically desirable—and needed. Isn't that possible,* TOO?

SELAS CORPORATION OF AMERICA

Heat Processing Engineers for Industry • • • Development • Design • Manufacture

PHILADELPHIA • 34 • PENNSYLVANIA

Now... a NEW BLAW-KNOX *Portable* FOGGER

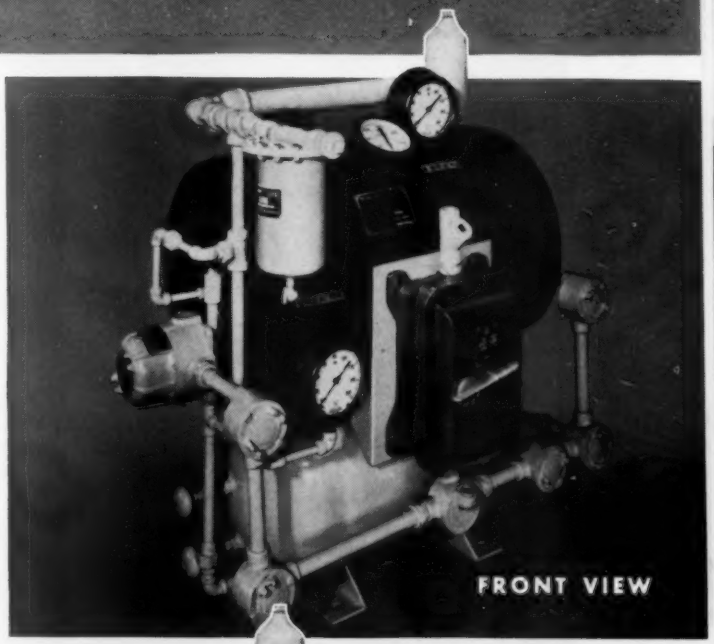
FOR LOCAL DISTRIBUTING POINTS

Just the size for your smaller City Gate Stations and District Regulator Stations

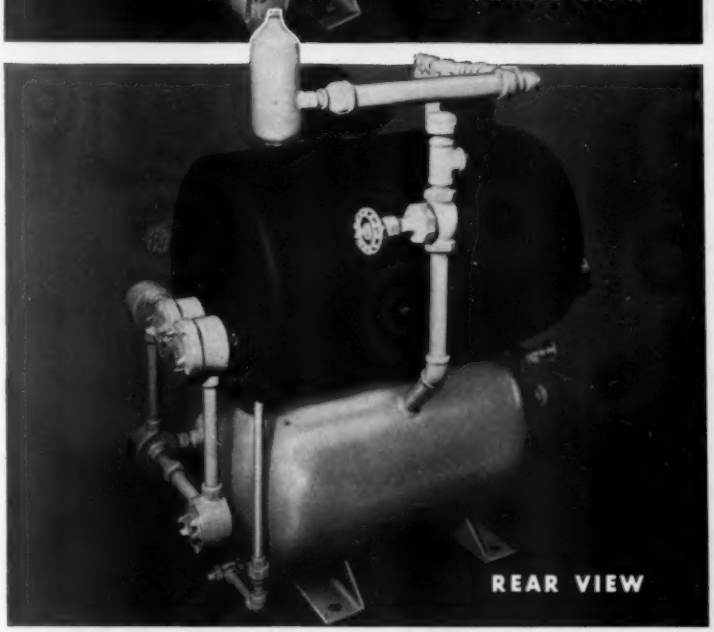
And like the larger Blaw-Knox Electroil Fogger, this new model is a *safe, explosion-proof, shop-assembled* unit which solves many natural gas distribution problems. The Portable Fogger produces a stable oil fog in the gas stream . . . safely, automatically and with minimum attendance or supervision. Being a shop-assembled unit it is ready to be connected "as is" to gas and electric power lines quickly and easily. For comprehensive data—

Write for Bulletin No. 2353.

1. **Simple to install.**
2. **Easy to operate.**
3. **Temperature control is completely safe and automatic.**
4. **Electrical equipment is explosion-proof.**
5. **It will produce a stabilized fog.**
6. **Wet down existing dust deposits.**
7. **Moisten leather diaphragm.**
8. **It coats inside of pipe with a protective oil film.**



FRONT VIEW



REAR VIEW

GAS EQUIPMENT DEPARTMENT

BLAW-KNOX DIVISION

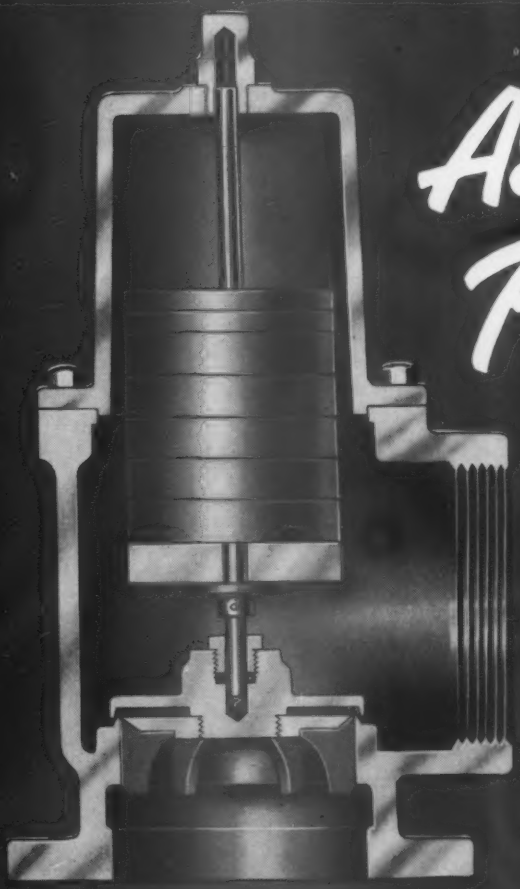
OF BLAW-KNOX COMPANY

2061 FARMERS BANK BUILDING
PITTSBURGH 22, PA.

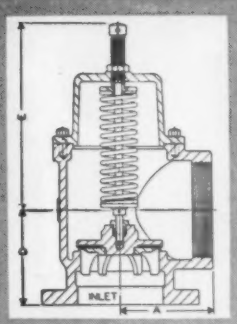
Assured Protection!

with

CHAPLIN-FULTON Safety VALVES



DEAD WEIGHT TYPE-250 DW



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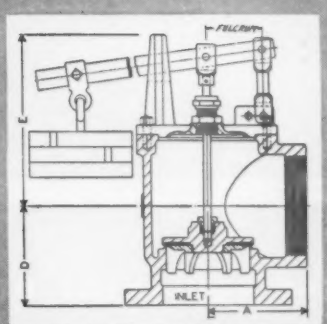

WEIGHT & LEVER TYPE-250 WL

Assured protection against overpressure is an essential feature in *good pressure control.*

The *CHAPLIN-FULTON* Safety Valve provides accurate predetermined relieving pressures with known discharge capacities, plus leak-proof construction.

Available in three types covering a wide range of pressure settings.

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MANUFACTURING COMPANY

Pittsburgh 23, Pennsylvania

*Write for Bulletin 250 and Technical Paper 104

Editorial:

A Time for Vision

IT is regrettably obvious that in their pell mell rush to natural gas many of the gas companies in New England are prepared to blithely ignore much of the advice and counsel that has been given them, on their own invitation, by engineers and executives of other gas utilities where conversion is an old story.

The first consideration is the matter of the therm rate. We thoroughly agree with Robert E. Ginna, vice-president of Rochester Gas and Electric Corp., who told the assembled New England Gas Association in March of 1950 that: "There is no question that therm rates rather than volumetric rates should go hand in hand with conversion." The same admonition, with a detailed explanation of how to go about instituting the therm rate in advance of natural gas arrival, has been voiced frequently by George F. Mitchell, President of The Peoples Gas Light and Coke Co., Chicago.

There is neither space nor necessity to delineate in detail all of the arguments that other experts have advanced in favor of the therm rate. They have been carried in all of the gas publications; expounded, extolled, broadcast and blueprinted so that it is inconceivable that any state commission or the public itself would be opposed to this logical basis of measurement.

Admittedly more complicated is the question of gas uniformity. In a recent address, before the New England Gas Association, Fredric O. Hess, President of the Gas Appliance Manufacturers Association urged the industry to explore the possibilities of arriving at a uniform mixed gas throughout that area. Our own survey, which may be found on pages 20 and 21 of this issue indicates that little heed was given to that sound and praiseworthy suggestion. Of the companies surveyed, 50 reported their intention of going to straight natural gas, while seven are planning to distribute either a mixed or reformed combination of lower calorific values. And of the latter seven, there are five different Btu values ranging from 528 to 800.

It may be argued that with 50 companies going to straight natural gas, they at least will be in the ranks of distributors of a uniform product. But when we consider the types of peak shaving and standby equipment that are to be used, including everything from propane-air to converted water gas sets, it appears improbable that there will be any uniformity in the specific gravity and the burning characteristics of the fuel sold by even this large group, which will serve high Btu gas to over three quarters of a million customers.

The entire gas utility industry has talked around this problem for twenty years. We know of no forthright attempt at its solution ever having been made.

It is not up to New England to carry the torch for the gas reforms of the nation, but as Mr. Hess rightly observed: "New England can take a national leadership if it has the will and the intent to achieve this major objective."

Turning to the 50 companies that are now proposing to go to straight natural gas, we are assailed by further misgiving. The companies reporting plans for such distribution are presently serving some 40 billion feet of manufactured gas per year to 800,000 customers. This equates to approximately 22 billion cubic feet of natural gas. These same companies have estimated their natural gas requirements for the first year of operation at 30 billion, with 62 billion projected for the fifth year of natural gas.

On a therm basis, this means that they envision an expansion of nearly two hundred percent in sendout. If this is accomplished, it is to be assumed that it will be in a large measure due to an increase in house heating saturation over the various systems. It appears from a study of the estimates that have been supplied of proposed expenditures for plant rehabilitation, and for the building of peak shaving and standby equipment that adequate consideration has not been given of the peak day problems that this saturation may impose.

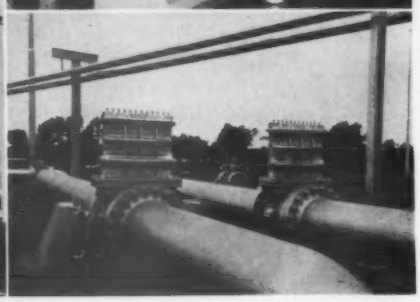
It would be unfair to pick any single company as an example; but since the total anticipated plant expenditures reported by the companies headed for a straight natural gas operation is only $5,800,000 it is difficult to see how that can be stretched to supply the necessary standby and peak shaving equipment. With an average of a little over $100,000 per company earmarked for this important phase of conversion, we leave it to plant engineers to estimate how much can be accomplished on such budgets. No outside observer can be expected to project a gas utility's future load and requirements with the accuracy that its own management should be able to achieve. But certainly where figures on anticipated gas requirements, for utilities operating in comparable areas, vary as widely as do those shown on the survey tabulation, it would only be prudent planning for many companies to re-examine the whole basis of their projections.

New England has waited a long time for natural gas. Its citizens have been propagandized by politicians into believing that natural gas will solve practically every problem, economic, social, industrial and domestic that has ever risen to plague the area.

Already many of its citizens expect more of natural gas than that admittedly superior fuel can ever be expected to accomplish. The gas utilities will have a delicate and difficult job to perform in just overcoming the misconceptions that have already arisen.

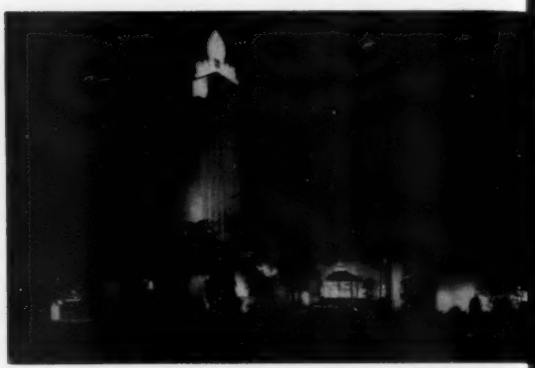
Elliott Taylor

The famous Dallas skyline—1951.



Above—Lone Star Gas Co. headquarters buildings.

Left above—Inside gasoline plant at Trinidad.
Left—Gas lines leading into Trinidad gasoline plant.

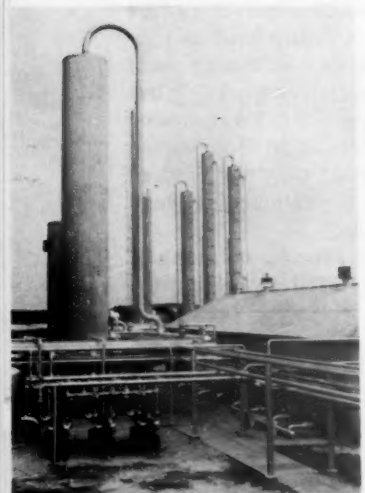


Exhibits building of Lone Star at State Fair, Dallas.

"Dallas is a vigorous young city, a leader of the great new region of opportunity. The people of the Southwest have the right name for her: Big D."
From the Dallas Chamber of Commerce

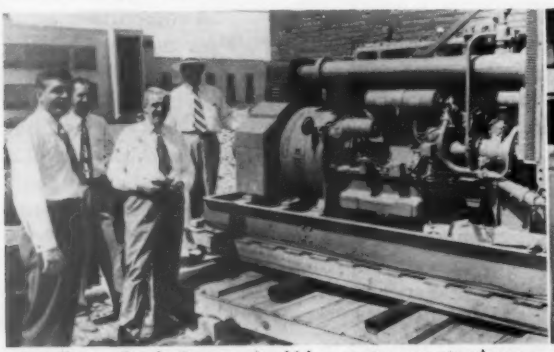
This Is Dallas and Lone Star Gas

HOSTS—1951 NATURAL GAS CONVENTION



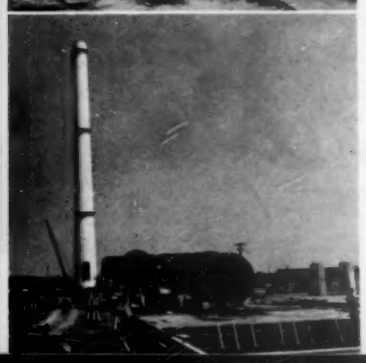
Left—Processing equipment at Trinidad gasoline plant.

Left, below—New gas-fueled kiln at Trinity Portland Cement Co. Consumption: 10,000,000 cu. ft. daily.



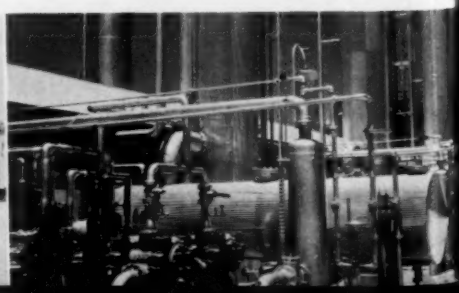
Installing a Ready Power unit which operates on natural gas.

Prover room at the central meter shop



Below: New North District shop and warehouse.

Below: Chapel Hill cycling plant.



57 New England Gas Properties Tell Plans For Use of Natural Gas

by Howard F. Weeks

THE year 1951 will have its full share of historically significant events. An important one of these from an economic viewpoint will be the introduction of natural gas into New England.

Work is proceeding on the laying of the two pipe line systems which are to serve this area. The first conversion of appliances is scheduled to start early this summer, dependent, of course, on the arrival of natural gas.

AMERICAN GAS JOURNAL has just completed (April 28, 1951) a survey of what the New England gas utilities intend to do with natural gas. The survey covered a total of 64 gas properties—and detailed answers were received from 57. The information is tabulated on the following two pages.

To summarize briefly:

A total of 50 properties intend to turn to the distribution of straight natural gas. These companies serve 804,000 customers, and in 1950 had sales of 41,700 MMcf of low Btu gas (averaging 530)—or 19,000 MM natural gas equivalent. These companies estimate that in the first year of natural gas service, their requirements will be 31,000 MMcf—and that, in the fifth year, load growth will require 64,000 MMcf.

Seven companies plan to turn to a mixed gas. They serve 532,000 customers, and in 1950 registered sales of 31,396 MMcf—or about 15,000 MMcf natural gas equivalent. Estimates of first year requirements of natural gas by this group are 10,940 MMcf, with requirements in the fifth year mounting to 19,981 MMcf.

Seven New England companies did not reply to the questionnaire. These companies serve 210,000 customers, and latest annual sales figures available amount to 5,553 MMcf, or about 2500 MMcf natural gas equivalent. The staff of the JOURNAL estimates that the first year requirements of these companies will amount to 3300 MMcf of natural gas, and will grow to 7400 MMcf in the fifth year.

The 57 companies replying to the questionnaire are going to spend a total of $9,000,000 for peak shaving and standby equipment. What is going to be done in this respect—LP, HiBtu, and storage—varies widely, and depends entirely on local conditions, as the table shows.

This map shows the territories served by the two New England pipe line companies:
—— is Northeastern.
—— is Algonquin.

Two natural gas pipe line systems will serve New England—Algonquin Gas Transmission Co. and Northeastern Gas Transmission Co.

Three transcontinental pipe lines will bring natural gas to the New York state-New England border.

Northeastern will receive natural gas from Tennessee Gas Transmission Co. at a point in Massachusetts and from Transcontinental Gas Transmission Co. at a point in Connecticut. Algonquin will take natural gas from Texas Eastern Transmission Co. at a point near Danbury, Conn.

Apparently, most of the New England companies look for appreciable increases in sales of gas with the introduction of natural gas.

For instance, the Malden & Melrose Gas Light Co., in suburban Boston, had sales of 2,557 MMcf of 539 Btu gas in 1950, and expects natural gas requirements in the fifth year to be 4,028 MMcf of 1000 Btu natural gas.

The Bridgeport Gas Light Co. is another example. With sales in 1950 of 3,083 of 528 Btu gas, the estimate of requirements of natural gas of 1000 Btu is 5,904 MMcf five years from now.

(Continued on page 56)

HOW NEW ENGLAND COMPANIES PLAN TO USE NATURAL GAS

	Present Btu	Annual Sales 1950 Mcf	Customers 1950	Requirements of natural gas—Mcf 1st year	5th year	Present process equipment & capacity	Proposed gas type	Btu	Type & capacity per day unless otherwise noted of equipment for peak shaving & standby	Estimated expenditure for plant equipment
CONNECTICUT										
Connecticut Lt. & Pr. Co.										
Waterbury	528	2,289,808	35,239	1,309,491	1,959,811	5 water gas sets 21,900 Mcf per day	Enriched Reformed	528	Conversion to reformed gas	$ 100,000
Norwalk	528	538,471	10,484	310,579	442,567	4 water gas sets 7200 Mcf per day	Enriched Reformed	528	Conversion to reformed gas	85,000
Willimantic	528	74,290	2,606	45,698	64,924	2 water gas sets 940 Mcf per day	Nat.	1000	Chg. to utilize nat. gas, nat. & LP storage	80,000
Putnam	528	76,629	2,633	48,076	64,159	2 water gas sets 940 Mcf per day	Nat.	1000		80,000
Winsted	528	124,203	2,259	77,040	99,249	2 water gas sets 1350 Mcf per day	Nat.	1000		80,000
Central Division (Bristol, Meriden, Middletown)	528	1,387,234	27,333	315,052	464,906	purch. coke oven gas	Mixed 660 coke oven & nat.		22,000 Mcf storage	475,000
Northern Division	528	236,376	6,840	53,948	72,094					
The Connecticut Pr. Co.—Stamford	528	726,084	16,966		2,723,300	2 water gas sets	Nat.	1000	LP; HiBtu oil gas; storage	27,000 for oil gas
Greenwich Gas Co.	528	443,366	7,805	351,425	561,185	purch. oven & water gas	Nat.	1050	125 Mcf/hr-LP	125,000
Bridgeport Gas Lt. Co.	528	3,083,849	53,500		5,904,400	water gas--11,500 LP standby—2,500	Nat.	1000	LP—3500 Mcf. HiBtu oil —12,000 Mcf	70,000
Derby Gas & Elec. Co.	530	486,217	10,146	28,800	42,100	3 water gas sets 5,000 Mcf	Nat. & mixture	HiBtu 1000	HiBtu oil gas—225 Mcf hour. Stor. 550 Mcf	300,000
Danbury & Bethel Gas & Elec. Light Co.	529	334,813	7,753		256,000	2 water gas sets	Nat.	1000	Connected with Derby Gas & Elec. which will maintain standby	
Wallingford Gas Co.	530	176,591	3,210	100,900	131,800	water gas—1000 Mcf	Nat.	1000		
New Britain Gas Lt. Co.	534	647,077	19,767	400,000	662,300	4 water gas sets	Nat.	1040	430,000 gal propane tanks. 2400 Mcf/day 1450 Btu propane-air gas. 2975 Mcf stor.	100,000
New Haven Gas Lt. Co.	528	4,424,000	74,603	1,100,000	1,800,000	coke oven purch. 11,-000,000 water gas 12,000,000 LP 2400	Mfg. Nat.	525 1000	LP 2400 Mcf Water gas 8000 Mcf	
Mystic Power Co.	510	39,643	1,225	33,453	134,663	purch.	Nat.	1000		
Hartford Gas Co.	528	3,906,332	65,500	1,212,000	2,816,300	water gas—12,000 Mcf/day LP standby—2400 Mcf/day purch. coke oven gas —7300 Mcf/day	Mixed	800	2,000 LP 10,000 oil gas	200,000
Norwich Gas & Elec. Dept.	529	337,753	7,223	267,269	425,516	water gas 2000 Mcf/day	Nat.	1000	LP planned at present	60,000
MASSACHUSETTS										
Springfield Gas Lt. Co.	581	3,209,410	62,345	2,095,010	4,625,032	coal gas 4500 water gas 11,100 LP standby 3000	Nat.	1000	LP—300 water gas—7200	
Holyoke Gas & Elec. Dept.	535	378,779	15,780	295,420	849,840	3 water gas sets 2400 Mcf	Nat.	1020	HiBtu—2000 Mcf LP—4000 Mcf	125,000
Fitchburg Gas & Elec. Co.	528	480,162	11,173	327,550	716,276	water gas 2101 Mcf coal gas 900 Mcf	Nat.	1050	HiBtu oil 2310 Mcf	20,000
Lynn Gas & Elec. Co.	1015	975,015	41,885	1,060,000	1,709,690	oil gas 11,000 Mcf	Nat.	1000	HiBtu	1,410,000
Lowell Gas Co.	660	1,026,277	27,012		2,641,500	1 oil gas set 2 water gas sets LP standby	HiBtu oil gas	1000 to 1050	1 heavy oil set—convert 2 water gas sets to HiBtu	
Haverhill Gas Lt. Co.	532	838,866	21,830	606,800	1,122,300	3 water gas sets	Nat.	1050	HiBtu oil 2500 Mcf	35,000
Westfield Gas & Elec. Light Dept.	535	215,535	5,022		245,800	2 water gas sets	HiBtu oil—1020 and Nat.		HiBtu oil 1825 Mcf	25,000
Northern Berkshire Gas Co.	535	311,703	10,056	253,646	629,028	water gas—2400 Mcf	Nat.	1000	HiBtu—1600 Mcf LP—1600 Mcf	19,000 120,000
Northampton Gas Lt. Co.	533	241,752	8,067	256,653	507,751	water gas—1500 Mcf	Nat.	1000	HiBtu—2300 Mcf	59,000
Central Mass. Gas Co. Webster Division	535	260,868	8,546	217,608	610,939	water gas—1900 Mcf	Nat.	1000	HiBtu—1300 Mcf LP—2400 Mcf	22,600 114,000
Spencer Division	535	18,166	1,031	23,021	184,976	water gas—430 Mcf	Nat.	1000		
Wachusett Gas Co. Leominster Division	532	116,488	5,343	121,038	374,051	water gas—1500 Mcf	Nat.	1000	LP—3000 Mcf	80,000
Clinton Division	666	56,323	3,002	58,008	185,869	purch. water gas	Nat.	1000	LP—1400 Mcf	98,000
Athol Gas & Elec. Co.	533	36,729	1,644	36,819	104,047	water gas—560 Mcf.	Nat.	1000		
Arlington Gas Lt. Co.	530	1,221,489	26,429	986,420	2,097,900	purch.	Nat.	1000	purch.	

HOW NEW ENGLAND COMPANIES PLAN TO USE NATURAL GAS

	Present Btu	Annual Sales 1950 Mcf	Customers 1950	Requirements of natural gas—Mcf 1st year	Requirements of natural gas—Mcf 5th year	Present process equipment & capacity	Proposed gas type	Proposed gas Btu	Type & capacity per day unless otherwise noted of equipment for peak shaving & standby	Estimated expenditure for plant equipment
Malden & Melrose Gas Lt. Co.	539	2,557,683	57,787	1,641,800	4,028,500	water gas—19,000 Mcf LP—7200 Mcf	Nat.	1000	HiBtu—18,000 Mcf LP—17,200 Mcf	993,000
Suburban Gas & Elec. Co.	536	472,767	15,535	390,170	1,024,900	purch.	Nat.	1000	LP—8000 Mcf	262,000
Salem Gas Lt. Co.	535	1,110,812	16,658	534,543	1,220,896	water gas—6000 Mcf LP—2000 Mcf	Nat.	1000	HiBtu—5600 Mcf LP—2000 Mcf	69,000
Beverly Gas & Elec. Co.	539	500,082	10,413	444,937	915,036	purch.	Nat.	1000	purch.	
Gloucester Gas Lt. Co.	537	170,435	5,936	148,408	365,331	water gas—1500 Mcf	Nat.	1000	HiBtu—700 Mcf LP—3000 Mcf Hortonsphere—200 Mcf	$ 15,000 137,000 100,000
Lawrence Gas & Elec. Co.	535	918,938	34,421	795,554	1,834,613	water gas—5100 Mcf LP—2000 Mcf	Nat.	1000	HiBtu—4000 Mcf LP—2000 Mcf	78,000
Worcester Gas Light Co Worcester	662	3,918,827	54,329	2,374,500	3,847,590	22,500 Mcf water gas; 4,800 LP	Nat. & oil	1000	Worcester & Framingham—7000 Mcf LP, 16,600 water gas, 11,475 storage	472,000
Framingham	662	1,318,965	9,251	1,762,400	2,565,061	9,375 water gas; 3,600 LP	Nat. & oil	1000		
Brockton Gas Lt. Co.	528	1,495,147	30,000	963,835	2,223,427	water gas 6000 Mcf oil gas 5000 Mcf 1000 Btu LP 2000 Mcf	oil gas LP	1000 1400	oil gas 2000 Mcf water gas 5000 Mcf LP 2000 Mcf	50,000
Cambridge Gas Lt. Co.	964	2,531,899 (528 Btu equiv.)	50,686	1,804,971	3,228,984	4 oil gas sets	Nat.	1050	528 Btu equiv. LP-4800; HiBtu—24,600; storage—17,100. 3—30,000 gal LP tanks	Already installed
Dedham & Hyde Park Gas Co.	664	651,791	9,758	502,208	858,537	purch. water gas LP Standby	Nat.	1050	LP storage 10,200 Mcf (528 Btu equiv.)	200,000
New Bedford Gas & Edison Lt. Co.	667	2,258,338 (528 Btu equiv.)	39,969	3,240,000	3,240,000	3 water gas sets LP standby	Nat.	1050	LP—3600 HiBtu—28,800 storage—8,000 (528 Btu equiv.) 5—30,000 LP tanks	380,000
Plymouth Gas Lt. Co.	516	86,745 (510 Btu equiv.)	2,486	59,400	117,200	coal gas, water gas purch.	Nat. Convert to LP-gas air this summer	1050	250 Mcf 1000 Btu—1st yr. 500 Mcf of 1000 —5th yr.	80,000 125,000
Boston Cons. Gas Co.	530	17,759,779	300,470	5,194,000	8,001,000	water gas—42,000 Mcf coke oven—43,000 Mcf LP—20,000 Mcf	Mostly mixed—small area probably natural. Mixed gas originally 580 Btu—later 680 Btu		water gas, coke oven gas, LP gas	500,000
Old Colony Gas Co.	530	1,093,000	19,623	1,500,000	4,500,000	purch.	catalytic cracking	530	LP-gasoline	500,000
Buzzards Bay Gas Co.	528 2,350	283,018 (528 Btu equiv.)	7,170	4,067	4,067	But-air 80 Mcf/hr Undil. Prop 160 Mcf/hr	Nat.	1000	But-air 80 Mcf/hr Pro-air 160 Mcf/hr	Already installed
Norwood Gas Co.	529	132,415	3,471	140,154	332,107	purch. coal, water gas	Nat.	1000	LP-2700 Mcf	120,000
NEW HAMPSHIRE										
Manchester Gas Co.	570	601,756	16,068	447,100	1,172,800	2 water gas sets LP standby	Nat.	1000	HiBtu (light oil)	100,000
Gas Service, Inc., Nashua	600	282,621	6,523	323,132	625,201	water gas 2500 Mcf includes 20% LP peak shaving	Nat.	1050	LP—6 day supply	40,000
Concord Gas Co.	525	240,103	3,770	159,500	310,400	water gas 1300 Mcf LP standby 500 Mcf	Nat.	1000	LP—30,000 gal.	40,000
RHODE ISLAND										
Providence Gas Co.	510	4,300,000	105,000		4,311,000	coke oven—10,500 water gas—13,000	Nat. or mixed	1050	LP HiBtu	?
Newport Gas Lt. Co.	510	410,458	8,100	527,101	634,289		Nat.	1000	HiBtu	330,000
Narragansett Elec. Co. Westerly	510	267,786	6,800	77,522	269,211	water gas	Nat.	1000	HiBtu 1000 Mcf	25,000
Bristol-Warren	510	(combined)		119,080	348,877	purch.	Nat.	1000	LP—1800 Mcf	120,000

New England Is Urged to Explore Possibilities of Uniform Gas

by Frederic O. Hess

President, Gas Appliance Manufacturers Ass'n
President, Selas Corporation of America, Philadelphia

Frederic O. Hess

I HAVE a faith in the inherent necessity of gas in our economic structure; a faith in a tremendous potential of the gas industry. Nowhere can this potential be more forcefully illustrated and proved than in New England, because once again, as often before, New England is the cradle of unusual opportunity to pioneer, to lead and to foster advances which not only benefit the gas industry but the entire national economy.

There is a trend among gas appliance manufacturers to abandon exclusive gas interest and establish competitive products—competitive only as far as the fuel is concerned—not as a manufacturing process or product. One of the most compelling reasons for this trend is the fact that many utilities establish local requirements for gas appliances instead of accepting AGA requirements.

Local Requirements?

It is history that the electric industry began its accelerated growth with the establishment and universal acceptance of the Underwriters' Laboratory seal. The gas industry established the AGA Laboratories to perform a similar function, but local narrow interests undermine this aim to the disadvantage of the entire industry. Suppose every town would establish its own requirements for television sets, radio sets or electric motors, or, for that matter, television tubes or electric switches or fuses only? Suppose every other town would have its own requirements for automobile carburetion, muffler or headlights to protect its citizens from exhaust fumes and blinding? We all know that progress would be stymied, production cost would be out of sight, maintenance and repair would be cumbersome, movement and travel would be prohibitive, costly and objectionable. Yet we tolerate these conditions in our own industry!

As long as we do not utilize our own laboratories for their intended and equipped purpose, we cannot complain about competitive inroads. Instead we guarantee our competition a 10 year handicap against ourselves, and we prevent our customers from obtaining the service and the equipment the entire industry is capable and obligated to furnish. Do we really have to increase the inherent problems arising from gas combustion, ventilation, ignition, impurities in gas supply and service? Let us all concentrate on these major factors intensely and nationwide, and not be diverted and compelled to devote time and effort to minor problems and local regulations. The benefits to our entire industry and national living standards would be of a magnitude which is hard to visualize, except by comparison with other unified industrial activities.

In this vein lies probably the biggest opportunity ever offered such a heavily populated and large area as New England to advance the gas industry as a whole. New England has approximately 6 per cent of the total population of the U.S., of which 17.4 per cent are gas customers, against 15.2 per cent for the balance of the country. That speaks well for New England—its high standards and concentrated population. On the other hand the fact that the average revenue per customer is only $60 annually against $72 for the balance of the country, would indicate obvious potential for expansion. This lower average is accounted for by substantially lower income per industrial customer because the average residential customer in New England accounts for $48.30 per year against $48.50 for the rest of the nation, or practically identical amounts. These figures are very interesting and illuminating, but for proper interpretation it is essential to make due allowance for price differentials per heat unit which exist now and will continue to exist in various parts of the country. The average residential consumption outside New England is over 3½ times the number of therms which is supplied to each New England domestic gas user.

With a safely predictable enlarging market in the offing upon the introduction of large quantities of natural gas, appliance manufacturers desire to be informed of plans, distribution and requirements. They wish to cooperate and coordinate with such plans to everybody's benefit. There is, however, also some concern about the conversion to natural gas, or more accurately mixed gas. All of New England will get natural gas of reasonably uniform composition and burning characteristics.

Unprecedented Opportunity

It is strenuously hoped that the New England gas industry has sufficient foresight and enough fortitude to end up with a uniform mixed gas throughout its area. If every town has its own mixture and therefore different Btu values and burning characteristics, the appliance industry and the public both will be severely penalized.

It is doubtful that the entire gas industry will ever have again the opportunity to standardize its fuel, as the electric industry has done; but at least New England has now a unique opportunity to do so for its area. All the local and technical problems—serious as they might seem—are insignificant to the tremendous gains which can be made in this area by a uniform gas supply—a gas supply which would afford standard equipment for the entire New England states instead of different burners, controls and heating results with all their complications of manufacture, shipment, service and mobility for the customer. New England can take a national leadership if it has the will and intent to achieve this major objective, this worthwhile dream of all forward-looking believers in the possibilities, potential and importance of the gas industry.

Now, right here should be an oppor-

(Continued on page 49)

From a paper presented at annual convention, New England Gas Ass'n, Boston, March 1950.

Summary of HiBtu Oil Gas Progress Shows Wide Adaptability Achieved

by Edwin L. Hall

Director, American Gas Association Laboratories, Cleveland

E. L. Hall

IN the early days of the natural gas industry a wide variety of fuel gas was used to supplement the then frequently inadequate supplies of natural gas. This practice was possible because the appliances in common use had pipe or star burners, were manually operated, and were partially adjusted by the operator each time the gas was lighted.

During past years the appliances in use have increased in efficiency and in performance characteristics. Most of the appliances that are sold today operate automatically and depend upon pilot ignition. In order to obtain maximum efficiencies, burners have been designed to fit the appliances, and the tolerances built into the appliances are rather small so far as the characteristics of the gas that may be used on the appliance without readjusting it are concerned.

In many localities today operators cannot conceive of augmenting the supplies of natural gas by any known manufacturing processes because the quantities involved are so tremendous; consequently, every effort is made to assure an unfailing supply of natural gas. In other localities, remote from natural gas supplies, some provision must be made for the production of peak load or emergency supplies.

Propane-air gas can be and has been used for peaks of short duration but the cost of the raw material and the cost of storage prohibit the use of relatively large quantities of this gas for peak loads at long duration.

Oil Gas

During the early part of the century the process known as the Pacific Coast Oil Gas Process received almost universal acceptance on the Pacific Coast. This was a very deep cracking process and the principal products were a gas of about 600 Btu, a large quantity of lampblack and some napthalene and pitch. Complete description and analysis of this process in its various forms are available in the Gas Engineers Handbook, Proceedings of the Pacific Coast Gas Association and elsewhere.

During the last few years a need developed for supplementing natural gas supplies, and processes for cracking gas oil or Diesel oil to make a gas of about 1,000 Btu were developed using the Pacific Coast Oil Gas apparatus or modified carburetted water gas sets, whichever were available.

Experience with the production of these high Btu oil gases for supplementing natural gas supplies was thoroughly developed over the past few years. In many parts of the country the price of oil compared to the price of solid fuels would permit savings in production costs and increased plant capacity if these high Btu gases were made rather than carburetted water gas. Distribution investment for new mains might be postponed because of the increased thermal value of the gas distributed. These and other advantages encouraged consideration of this high Btu oil gas as a town gas supply. The first city to distribute high Btu oil gas as a base supply was Cambridge, Mass. Cambridge's experience has been summarized in articles by Hall M. Henry.[1]

The oil gas produced by modern high Btu processes is characterized by the presence of relatively large amounts of hydrogen, paraffins and olefins. Significant amounts of aromatic hydrocarbons are commonly produced but only a small proportion remains in the gas. The amount of inerts will vary depending upon the amount that is deliberately or inadvertently included due to the type of operation used. Ordinarily, high Btu oil gases contain relatively small concentrations of inerts, or of water gas. In the absence of the dilutive action of the latter substances, in order that the final product is of desired thermal content and stability, the oil must be cracked more intensely than is usual in carburetted water gas practice. As a result, oil gases have significantly large concentrations of hydrogen and of unsaturated hydrocarbons.

The large amount of hydrogen so produced has a tendency to cause some appliance burners to flash back if excessive quantities of oil gas are used to supplement natural gas unless the burners are properly adjusted for both gases. The olefins produced, but more particularly the aromatics, may tend to develop yellow flames on appliance burners when oil gas is substituted for or added to natural gas. Flash-back tendencies caused by the hydrogen can be modified by the introduction of relatively small quantities of inerts, but before this flashback is entirely corrected, the gas so produced may tend to enter a region where it starts to lift from the burners and an effect of "motorboating" or alternate flashback and lifting is produced if the burners are maladjusted for the supplemental gas mixtures.

In considering means and methods for producing satisfactory oil gases, three major factors must be considered. These factors are:

1. The influence of the oil or the hydrocarbon that is used in the process.
2. The influence of cracking conditions or the process selected.
3. The influence of the treatment of the gas produced.

Influence of Oil

The influence of the oil or the hydrocarbon that is used in the process is primarily related to the carbon-hydrogen ratio of the fuel. Since the gas produced consists primarily of hydrogen, paraffins and olefins, it is obvious that an oil containing a large proportion of hydrogen will yield a comparatively large amount

[1] Higher Btu Gas from Existing Plants Shows Substantial Advantages—"American Gas Journal," 171: Nov. & Dec. 1949.

The Manufacture & Economics of Oil Gas—Hall M. Henry, "Gas Age," 106:32-6 Aug. 17, 1950.

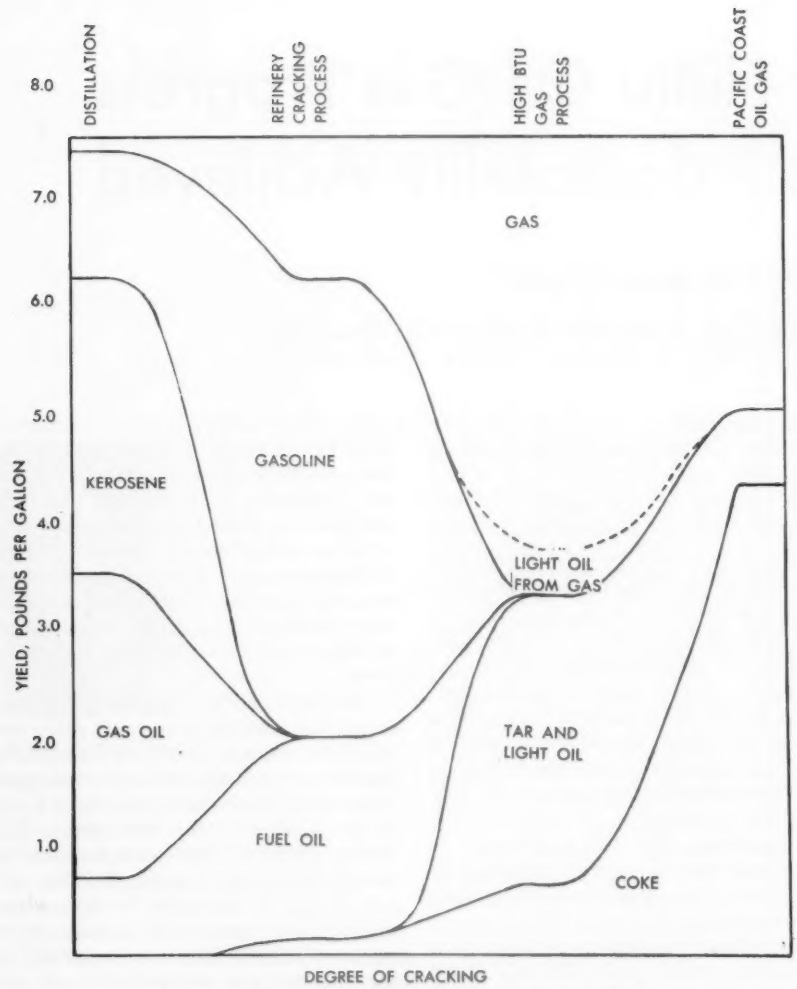


Fig. 1—Products of oil cracking by various methods.

of gas. On the other hand, an oil of low hydrogen content, such as a tar, will yield little gas and most of this gas will be hydrogen.

Almost any oil with a reasonable carbon-hydrogen ratio may be used in some of the various processes available. The limitations normally imposed upon the plant operator are as follows:

(1) Oil Handling—does the oil require heating in order to pump it? Plant unloading and handling facilities must be adequate.

(2) Gas Yield—must be reasonable compared to the price of the oil and the other factors of plant operation.

(3) Tar Yield—plant facilities must be adequate for handling the tar or tar emulsion produced under the selected gas making conditions, the ability to use or market dry tar or emulsion must be determined.

(4) Carbon produced—may be a fuel credit or a liability.

The oils commonly used may be generally described as:

Gas Oil

Gas oil is a petroleum refinery fraction commonly boiling just above kerosene and below light lubricating oil, about 30 to 38° API, low viscosity and low free carbon. It was originally in plentiful supply but is now largely used for Diesel fuel and domestic fuel oil. It has the same low carbon-hydrogen ratio as required for Diesel fuel. Many operators now refer to the oil by its common market name, Diesel fuel or oil. Light crudes such as "Lima" and others are also used. Gas oil requires very little if any heating to be pumped and handled. It produces no tar emulsion under proper operating conditions and it leaves only a small amount of carbon residue in the apparatus. Gas oil operation usually permits a relatively wide selection of cracking condition which will produce the gas desired and at the same time make a tar that can be handled.

Heavy Oils

This is a rather general term including still residuum oils, fuel oils and relatively heavy crude oils. Still residuum from topping stills operating on paraffinic or napthenic crudes are usually very desirable for gas making. Cracker still bottoms approach tar characteristics and are of slight value for gas production. Fuel oils are normally blended to meet specifications relating to pumping, boiler firing, etc.

For example, "Bunker C oil, viscosity not more than 300 sec. Saybolt Furol at 122 F, flash point 150 F minimum, not over two per cent water and sediment, now commonly called No. 6 fuel oil." Other fuel oils such as Nos. 4 and 5 may also be used in the gas industry.

It is common practice to blend heavy residuum oils with cracker tar bottoms or with gas oil in order to meet the viscosity specification of the fuel oil market. Residuums cut with gas oil may be good gas making oils if the required cracking temperature of the two fractions correspond. Fuel oils may develop tar emulsion trouble in the plant if the required cracking temperatures for the two fractions shows any great variation. Fuel oils cut with cracker tar may be satisfactory if the residuum oil used is of good quality and represents a sufficient proportion of the mixed fuel. Aromatic oils are usually desirable for a viscosity requirement and almost useless for gas making so that the operator must be very cautious in selecting heavy oils and more particularly in considering fuel oils.

These residuum oils tend to have relatively high Conradson carbon content. The amount of this carbon or coke will of course depend upon the still charging stock and the type of refinery operation.

Certain heavy crude oils such as "Mirando" have been quite sucessfully used for gas making. These crudes are frequently available because of their low gasoline fraction and while not as desirable for refinery operation as lighter crudes, they may be quite satisfactory for gas making.

The paper by Linden[1] noted below contains a bibliography that should be reviewed by those interested in purchasing oil so that a proper selection of the fuels to be considered may be made.

After all of the fuels to be considered are selected on the basis of their indicated enriching value characteristics and relative price, the operator should then try sample runs of the two or three best oils in order to determine whether or not the oil, and the tar or tar emulsion produced, can be handled in the plant. The experience of other operators may furnish a valuable guide, but the variation between plant facilities can lead to trouble if contracts are made before proper plant trials. It is frequently pos-

[1] Method of Estimating Oil Gasification Yields, Henry R. Linden, Production and Chemical Conference, American Gas Association, May 1949.

sible to obtain residuum oils or other oil fractions below the market price for fuel oil because such fractions may not meet fuel oil viscosity requirements. Such fractions may contain all of the good gas making qualities of the fuel oil and none of the poor gas making characteristics of the fraction used to cut the residuum to the fuel oil specifications.

Oil Handling Equipment

The oils that may be used for producing high Btu oil gas vary from natural gas gasoline to heavy oils. Many gas plants will find it necessary to install special heavy oil and tar handling equipment if an attempt is made to use oils heavier than gas oil. It may also be necessary to take special precautions if an attempt is made to use lighter oils such as natural gas gasoline because of the particular hazards involved in handling the more volatile fuels and the lighter tars produced from such fuels.

Influence of Cracking Conditions

The oil gas analysis is a function of the cracking conditions. Low temperatures will tend to yield relatively large amounts of paraffins but the total oil gas yield is frequently so low as to make the process unacceptable from an economic standpoint. High temperatures tend toward the production of hydrogen and lampblack as in the Pacific Coast process. It has been shown by many investigators that the analysis of the oil gas will tend to vary in reasonably smooth lines between the low temperature and high temperature cracking conditions.

Chart No. 1 is a diagram indicating the relative proportions of the products resulting from various intensities of cracking of representative oils—ranging from the relatively low degrees of cracking used in petroleum refinery operations, to the high degree of cracking used in the Pacific Coast low Btu oil gas process. As will be seen in this chart, the degree of cracking in the high Btu oil gas process may be visualized as being intermediate between refinery cracking still operation and the Pacific Coast oil gas process. This chart indicates that a simple distillation by oil refinery practice of an oil will yield fuel oil, gas oil, kerosene, a small amount of gasoline, and a trace of gas. Refinery still cracking processes tend to yield a small amount of coke, a substantial quantity of fuel oil, a large gasoline yield, and a measurable amount of gas. The high Btu gas processes crack the fuel oil and gasoline to gas, tar and additional coke. The Pacific Coast oil gas process cracks some of the high Btu gas as well as the tar to yield larger quantities of coke and a smaller gas yield when expressed in pounds per gallon of oil.

For the sake of simplicity this chart does not show the pitch as separate from the tar and coke. It only indicates that an indefinite amount of light oil may be scrubbed from the gas since this is obviously a function of plant operation.

Cracking conditions are of paramount importance in determining the quantities, compositions and thermal contents of oil gases—the condition of greatest importance being the cracking temperature. A number of investigators have reported that there is a definite tendency for oil gases produced by cracking at atmospheric pressure to have compositions that are directly related to the cracking temperatures—the nature of the original oils having little or only an indirect effect.

Oil gases produced at relatively low temperatures will tend to be heavy, slow-burning, and of high thermal content; they may contain as much or more unsaturated hydrocarbons (ethylene, propylene, butylene, etc.) as saturated hydrocarbons (methane, ethane, etc.), and will have relatively small hydrogen contents. Under such conditions the total gas yield is so small as to be uneconomical. As the cracking temperature, or the intensity of cracking, is raised, the concentration of unsaturates in the oil gas decreases, the concentration of hydrogen increases, there is a slight increase in the saturated hydrocarbons—and the gas as a whole has a lower thermal content, a lower density, and is faster burning. A further increase in the cracking temperature results in a reduction of the unsaturates to a minimum, a decrease in the olefins, a slower decrease in aromatic compounds, and a large increase in the free hydrogen—so that the gas produced is light and fast burning. High temperatures tend toward the production of large quantities of hydrogen and lampblack, as in the Pacific Coast low Btu oil gas process.

Attempts have been made to improve the burning characteristics of oil gas by increasing the cracking temperature and so decreasing the total "illuminants" as shown by Orsat analysis. These attempts have usually failed to decrease the yellow flames produced by the oil gas because such a procedure decreases the ethylene but increases the benzene, and as a result the total "illuminants" decrease but the yellow flame tendency of the oil gas seems to increase.

Because of their effects in determining flame characteristics, it is desirable that

TABLE 1—HIGH BTU GASES FROM GAS O.I. OR DIESEL OIL

Analysis	San Rafael Calif. (1) Diesel Oil		Recirculated Oil Gas (2) Pettyjohn	Refractory Screen (3) Process	Down Blast Process Blain (4)	Coke Fire (4) Detroit	Buffalo, Twin (5) Generator Process	
CO	1.8	3.2	2.8	5.4	.9	8.0	1.8	1.4
H_2	14.0	21.7	31.0	27.7	22.9	30.0	11.5	10.5
Ills.	27.2	20.7	24.2	28.6	22.4	23.0	29.0	27.1
C_2H_4	—	—	—	4.9	—	4.0	2.2	2.0
CH_4	48.6	48.0	33.8	28.5	42.7	26.0	31.4	31.0
CO_2	1.4	1.9	2.6	2.0	1.6	1.2	2.7	2.9
O_2	0.6	0.2	0.4	0.4	1.2	0.8	3.2	2.9
N_2	6.4	4.3	5.2	2.5	8.3	7.0	18.2	22.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Btu	1085	975	1030	1100	970	940	1000	980
Sp. Gr.	.726	.661	.726	.740	.660	.680	.800	.840
PRODUCTS OF COMBUSTION AND AIR								
CO	—	—	—	—	—	—	—	—
CO_2	1.0	0.9	0.9	0.2	0.9	1.0	1.4	2.7
O_2	0.6	0.2	0.4	0.4	1.2	0.8	3.2	2.9
N_2	6.4	4.3	5.2	2.5	8.3	7.0	18.2	22.2
Total	8.0	5.4	6.5	3.1	10.4	8.8	22.8	27.8
BLUE GAS								
CO	1.8	3.2	2.8	5.4	0.9	8.0	1.8	1.4
CO_2	0.4	1.0	1.7	1.8	0.7	0.2	1.3	0.2
H_2	2.6	5.2	6.2	9.0	2.5	8.4	4.4	1.8
Total	4.8	9.4	10.7	16.2	4.1	16.6	7.5	3.4
Btu	15	27	29	47	11	53	20	10
OIL GAS								
H_2	11.4	16.5	24.8	18.7	20.4	21.6	7.1	8.7
Ills.	27.2	20.7	24.2	28.6	22.4	23.0	29.0	27.1
C_2H_6	—	—	—	4.9	—	4.0	2.2	2.0
CH_4	48.6	48.0	33.8	28.5	42.7	26.0	31.4	31.0
Total	87.2	85.2	82.8	80.7	85.5	74.6	69.7	68.8
OIL GAS ANALYSIS								
H_2	13.1	19.4	30.0	23.3	24.0	29.0	10.2	12.7
Ills.	31.2	24.3	29.2	35.4	26.1	30.8	41.5	39.4
C_2H_6	—	—	—	6.1	—	5.3	3.2	2.9
CH_4	55.7	56.3	40.8	35.2	49.9	34.9	45.1	45.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Btu by difference	1220	1110	1210	1300	1120	1180	1410	1410

(1) Proceedings Pacific Coast Gas Association 1932—Harritt, Wills, Willien
(2) AGA Proceedings 1933
(3) "Gas Age-Record" June 18, 1932
(4) AGA Proceedings, 1942
(5) R. J. Chambers, 1947 AGA Production & Chemical Conference

the ratio of saturated or paraffinic hydrocarbons (methane, ethane, etc.) to unsaturated or olefinic hydrocarbons (ethylene, propylene, etc.) in an oil gas be as high as possible—particularly if the gas is to be used in conjunction with natural gas.

Some displacement of the olefin versus paraffin yields may be obtained by the use of steam or other atmospheres. The use of hydrogen as a cracking atmosphere will tend to increase the paraffins but the amount of hydrogen used is relatively large and the problem of separating the hydrogen from the oil gas so produced appears to be outside normal economic considerations except as this effect may be obtained by some recycling. This general tendency of the oil gas to show little variation in composition when cracking to a selected thermal value at atmospheric pressure is repeated in the reports of all investigators.[2] Research on this problem is continuing, however, because of its importance to the gas industry.[3]

Influence of Gas Treatment

The influence of gas treatment with respect to the condensing and cooling systems used has not been emphasized in most reports. Frequent reference is made to the type of oil gas produced by one process as compared to another without taking into account the type of condensing and scrubbing system used or without considering whether any oil scrubbing or other means for removing heavier hydrocarbons may have been used in one plant and not in another. Needless to say, proper treatment by condensing, tar removal, purification and oil scrubbing, if necessary, is desirable in order to produce a stable gas for distribution.

Oil gas analyses are commonly reported as shown by Orsat as in Table No. 1. With this method of analysis the paraffin hydrocarbons are reported as methane and ethane and all other hydrocarbons as "illuminants." The so-called methane and ethane may be divided actually into methane, ethane, propane, butane, and even traces of pentane. The so-called "illuminants" will include ethylene, propylene, butylene, butenes, butadience, cyclopentadiene, isoprene, acetylene, methylacetylene, benzene, toluene, xylene, styrene, methylstyrene, and indene. In the normal oil gas plant most of the heavier hydrocarbons are removed in the ordinary condensing and scrubbing system, but it is not uncommon to have relatively large amounts of C_5 hydrocarbons and benzene left in the gas.

Tar

In the selection of an oil gas process, it must be remembered that relatively large quantities of tar will be produced. For the same oil and the same degree of cracking the quality of the tar from high Btu oil gas operation will tend to be better than the quality of the tar when making carburetted water gas, because of the presence of greater amount of light oil in the tar and the absence of ash and blown over fuel from the solid fuel bed. This tendency, however, will not overcome the problems of heavy oil tars and oil selection must be based not only upon price but upon the ability of the plant auxiliaries to handle the tar produced.

Most operators have found that tar quality is a valuable guide to the set operation. As shown by an article by N. K. Chaney, E. L. Hall, J. R. Skeen and E. H. Smoker published in *Chemical Engineering Progress* in January 1949, the sulfonation residue and free carbon in the tar may be used as an index for the depth of cracking of the oil and as a measure of the homogeneity of cracking.

Tar Handling Equipment

With the ordinary gas oil, the tar produced is of good quality with low free carbon, low viscosity and little tendency to form emulsions unless the oil is drastically overcracked. Using gas oil, the amount of tar produced usually exceeds the amount produced in carburetted water gas plants since more oil is used, but the tar handling facilities are normally adequate to care for peak load production. As compared to gas oil operation when heavy oils are used, or when light oils of the fuel oil type are used, the amount of tar produced will be greater and the free carbon content of the tar and the tar viscosity will usually tend to increase. Another characteristic of heavy oil tars is that they may form very stable emulsions. These emulsions must be dehydrated, preferably before they are stored, since the storage facilities will normally be inadequate to store the emulsions containing as much as 70 per cent water. All of these tars are high in resin content and polymerize rapidly if maintained at elevated temperatures. For example, a tar with a viscosity of 500 SSU at 250 F may increase in viscosity to 1800 SSU at 250 F after 1½ hours heating at this temperature.

Most plants will not find it economical to use materials lighter than gas oil, but if such materials are used, special precautions are sometimes necessary in handling the light tars produced which may consist principally of aromatic light oils that will float on the separators rather than settle as do the usual tars.

General

In selecting the oil gas process to be used, it should be remembered that the actual gas making apparatus represents a very small portion of the total plant cost. It will, therefore, represent false economy to devote too much attention to the savings possible by skimping on oil gas apparatus and then find that large sums of money must be invested in auxiliary equipment to care for the product produced.

To repeat then, the two problems that must be answered by most operators are the selection of raw materials and the selection of equipment. The selection of proper oil will save not only a great deal of money but a great deal of trouble for the plant operators. The Gas Production Research Committee of the American Gas Association has pursued the work of other investigators and there is a wealth of literature available to enable the plant operator to guide his purchasing department in the selection of oils to be plant tested prior to a final selection. A bibliography on the selection of oils for gas making was mentioned on page 24, and any plant should be able to use some of these methods for oil classification. For most small plants the specific gravity and viscosity determinations are easy to make and present a valuable guide to oil selection. The work of Cauley and Delgass, Kugel and Bliss, and of Linden at the Institute of Gas Technology are recommended as required knowledge for oil selection.

Selecting of Processes

The conditions of operations must be a guide to the process chosen. Under conditions of stand-by service or of occasional peak load, there is every incentive to use either existing apparatus or minor modifications of existing apparatus. A process that is easy to operate with a fuel that is not only easy to handle but will give maximum gas yields should always be selected for these conditions.

Where large quantities of gas must be produced, the savings available by the installation of an economical process cannot be neglected. The Hall regenerative process as shown in the reports of the Baltimore operation was about five per cent more efficient than comparable non-regenerative processes operating with the same oil. This regenerative process can also use good heavy oils having high free carbon content which cannot be economically used in other processes. It, therefore, not only permits better operating efficiencies but more flexibility of fuel selection.

When cracking gas oil, the make oil required is usually about 10 gallons per Mcf and the fuel oil will vary between 1 and 1½ gallons per Mcf. In most of

(Continued on page 50)

[2] Degree and Extent of Cracking Gas Oils—Hugh E. Ferguson, "Gas Age," August 27, 1942—September 10, 1942.

[3] Methods of Estimating Oil Gasification Yields—Henry R. Linden, technical paper, May 1949, Production & Chemical Conference, American Gas Association.

Accurate Temperature Forecasting Helps In Gas Operations

by William J. Hartnett

President, Weathercasts of America, St. Louis

W. J. Hartnett

TO minimize the weather factor in gas dispatching is part of the comparatively new business of industrial meteorology. How important is the weather factor in gas demand? How much can forecasting assist in estimating send-out? How accurate can weather data be? And how can the science of meteorology better serve the gas industry? Perhaps the results of day-to-day service to such companies as Panhandle Eastern Pipeline Co., whose line runs from Texas to Michigan, Laclede Gas Co. in St. Louis, and Citizens Gas and Coke Co. in Indianapolis will be of value to others in the industry.

As every transmission expert knows, the weather is the most important single factor in gas demand for any given day.

The value of forecasting can be illustrated in the operations of two types of users of our service, the pipe line and the city gas utility. For a pipe line with high load factor and increasing demand, the major problem in which forecasting can assist is maintaining the line pack at optimum level. For a typical city gas company, weather knowledge helps meet peaks in gas usage while holding the demand charge paid to the supplier to the lowest possible level. The type of forecasts required, and their frequency, vary from company to company as the effect of weather on operations varies.

We can make some generalizations. Gas dispatchers exercise greatest control of daily send-out estimates by determining the probable take in house heating areas through temperature predictions and then adjusting other factors to fit this demand. Diversity in utilization is usually expected to equalize demand fluctuations caused by factors other than temperature.

Accuracy in temperature forecasts is of prime importance, although the word accuracy, as applied to weather forecasting, requires interpretation. As the accompanying chart shows, accuracy increases as the time element shortens. The nearer we approach the time for which a forecast is made, the closer we can predict weather conditions. It is our opinion, concurred in out of experience by gas companies, that the long-range general forecast is of very little use to them.

In actual practice, accuracy is achieved by multiplying the frequency of forecasts and forecast corrections and revisions. The 72-48-24 and 12-hour forecasts are constantly revised, and either confirmed or corrected every few hours. In addition, emergency warnings are issued when necessary.

The gas dispatcher sets his plans on the basis of the 48-hour forecast, which is essential for smooth operation. Often, little change is required for this forecast. Sometimes, weather which meteorologists call "difficult to predict" occurs, at which time "doubtful" forecasts are issued. These tell the dispatchers to take no unnecessary steps to increase or decrease supply until absolutely required. During such periods the trend is closely watched and the dispatchers are alert to revise plans if the weather reverses itself, as it sometimes does.

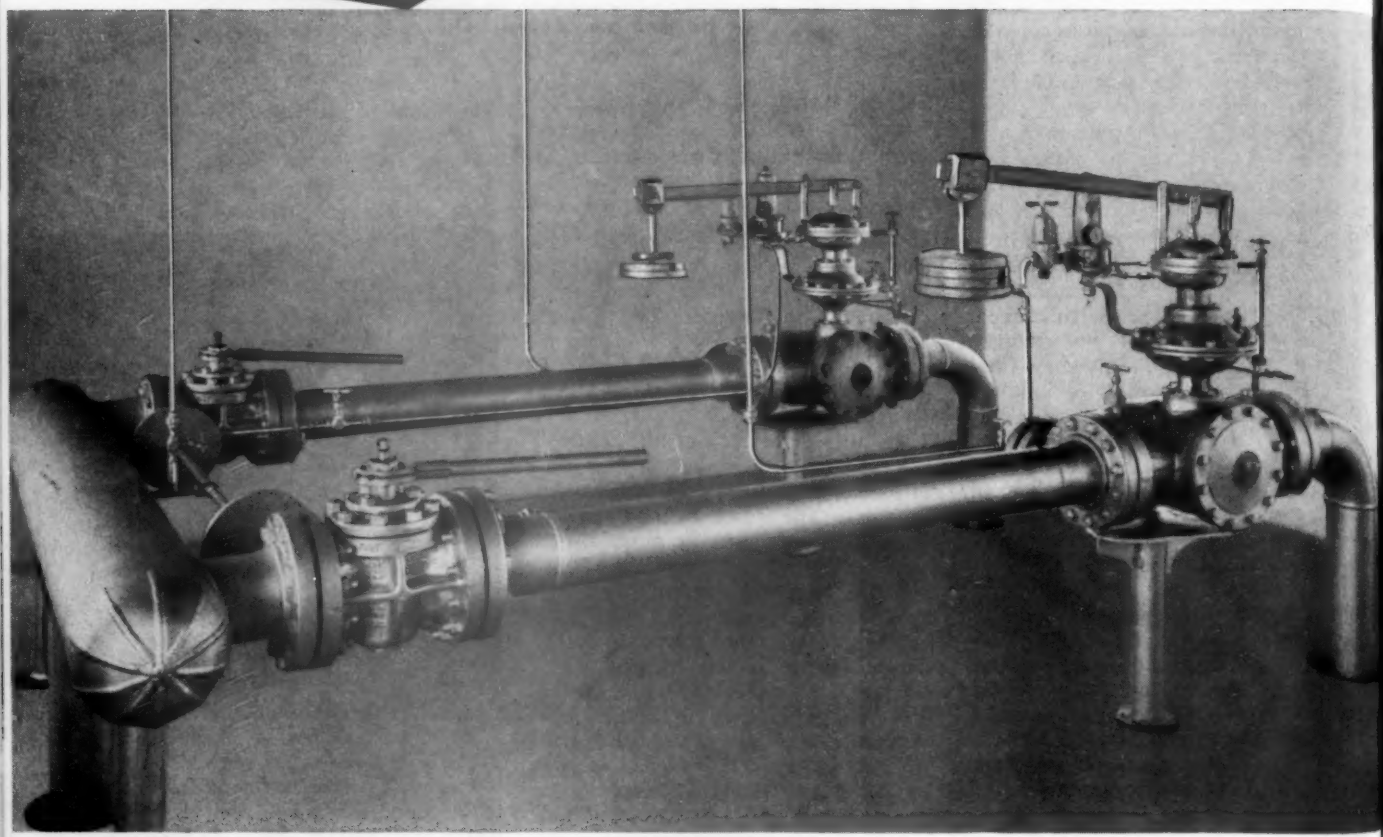
To see this type of close-range forecasting put to use, we might go first to the modern dispatching center of the Laclede Gas Co. in St. Louis, where crews on 24-hour duty watch instruments charting gas supply at 21 centers, and operate regulators by remote control which compensate for predicted peaks or drops in pressure. This company's operation is fairly typical of companies serving metropolitan areas in which supply has not caught up with demand.

Laclede uses manufactured gas to supplement natural gas for peak load, and weathercasts are used first to avoid peaks which would establish a higher demand charge from Laclede's supplier, Mississippi River Fuel Co. By trimming off these peaks with manufactured gas the demand charge is held to the established level. Forecasts tell when to cut back the manufactured gas plant, or what proportions of water gas, oil gas, and propane gas will be used to supplement natural gas if the peak load goes up. This company is most interested in forecasts for temperatures ranging from 32 degrees to zero, although others

Edward Trunk, design engineer, Laclede Gas Co., shows plaster models, each based on a series of days in which daily temperature averages ranged from zero to 32 degrees. One model charts an hourly load pattern with rising temperature gradient, the other a falling temperature gradient.

Load dispatching center at Laclede Gas Co. Dispatcher Billeadeu is at instrument board; dispatcher Di Fiore at desk takes calls from manufacturing and pumping stations.

Safe, Sure,



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The installation pictured shows Rockwell Balanced Valve Regulators at a town border station making a precise primary reduction of high pressure gas. For sensitive response these regulators are equipped with pilot loading heads. They have the added protective feature of auxiliary lever and weight control to guard against over-pressure or under-pressure on the outlet side. The auxiliary control is non-operative when the pilot loader is functioning but will automatically cut in should the controlled or outlet pressure fall below the proper amount. This type of control is only one of many Rockwell balanced valve regulators designed to provide safe, sure, sensitive control of either high or low pressure gas. All give you the service convenience and economy of a removable inlet bowl assembly that can be changed while the regulator remains in the line. Write for bulletins 1006, 1055 and 1080.

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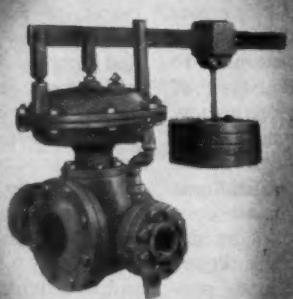

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WITH THE EXCLUSIVE ROCKWELL REMOVABLE INLET BOWL* FEATURE

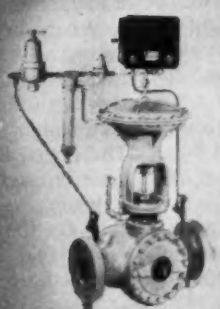
Keep everything under control now and later! It's easy to do when you select your big regulators from the complete Rockwell line. You get your unrestricted choice of size and type. Later, if capacities and or pressures change, your regulation problems are minimized thanks to the removable inlet bowl (valve chamber*) feature.

You don't need a crystal ball to envision changing conditions. You can economically meet these changes with Rockwell regulators. Just look ahead to your possible future requirements at the time of installation. Then you need only change the inlet bowl assembly to handle increased or decreased demands. This unit is easily removed through a hand hole area in the side of the regulator body. It takes no sleight-of-hand to perform this operation. A new or rebuilt replacement assembly having soft, semi-steel or tool steel valves can be quickly installed. *You do it while the regulator remains in the line.* Many utilities take advantage of this feature to meet seasonal demands. The Rockwell removable inlet bowl brings big savings to you who use big regulators. Write for full details.

FOR EVERY VOLUME AND PRESSURE REQUIREMENT

HIGH PRESSURE
Pilot Loaded Type

HIGH PRESSURE
Pilot Loaded with Auxiliary Lever and Weight Control



HIGH PRESSURE
Instrument Control

LOW PRESSURE
Either outside or inside weights

Valve Regulators

ROCKWELL

watch the temperatures closely as soon as they fall below 65 degrees.

Two factors affect the day's load. The average temperature throughout the day and the difference in temperatures at the beginning and close of the gas day—7:00 a.m. to the following morning at 7:00 a.m. A temperature difference of five degrees at these points will affect the day's load pattern.

Weathercasts are given on a 72-hour basis, for the first and the second 36-hour period, with confirmations or revisions furnished every six hours. Also reported are weather conditions along the pipe line from Louisiana, so that dispatchers can know of developments along the line which might affect the supply in St. Louis. This close check on weather makes it possible for the company to keep its estimated demand very close to actual output; on this schedule, near perfect estimates are the rule.

A rather unique method of studying weather and gas demand correlations has been developed by Laclede's design engineer, Ed Trunk, who makes three dimensional plaster models which show load peaks under different temperature conditions. These models reveal the temperature-demand curves clearly and dramatically and have assisted in developing the formulae necessary in analyzing effects of weather factors.

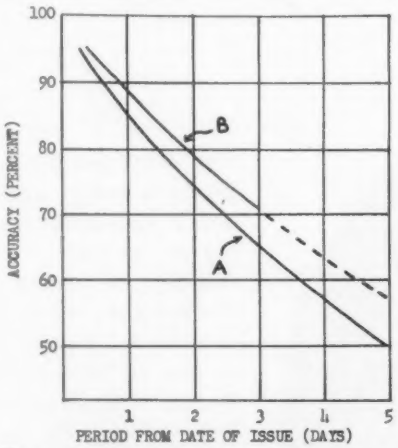
These models also reveal a lot about the living habits of the community. Beginning Friday afternoon, when industry cuts down for the week-end, the load drops by about four million cubic feet, and by Saturday and Sunday, a drop of 10 to 12 million cubic feet from normal load is shown. The peak of demand is Monday morning, when schools, office buildings, and industry are opening up. Any day's peak is in the morning when turned-on thermostats and breakfast-time overlap. From the Monday high, the load drops slightly and holds fairly steady until Friday. During the week most people go to bed around 10:30; Saturday nights, it's a little later, and on New Year's Eve, it would appear that St. Louisans merely welcome in the New Year, for the load carries only until about 12:30. Regular mealtimes show up as peaks on the curve, and on holidays, there is a definite bump when the turkeys go into the ovens.

The growing use of many gas appliances in homes increases consumption but has little effect on the peaks and valleys of demand, it appears.

People who have gas driers throw away the clothesline and use the drier even on fair days. Ranges and water heaters add their heat to the furnace heat, thus equalizing any peaks they might create. It is estimated that three fourths of the heat of these appliances goes into house heating, thus taking the place of additional gas for the furnace.

Other companies tell us that more gas is used per degree day in warmer weather than in periods of severe cold. Much of this is attributed to the human factor—people grow careless of gas consumption in warmer weather. In severe cold, appliances are used to the maximum of their capacity, and this also affects the ratio.

Forecasting for a pipe line, as opposed to a city utility, calls for a slightly different technique. Again, the highs and lows and variation between beginning and end of the gas day are important, but here the demand must be calculated for many points along hundreds of miles of line. A reliable forecast of temperatures through principal house heating



Curve A represents pre-war average accuracy of all forecasting. Curve B is Weathercast's average accuracy.

areas gives the pipe line greatest control of its gas deliveries, and makes it possible to operate at most efficient pressure level—that is, within the normal pack or volume of gas in the main line.

For this operation, forecasts are given for key house heating points along the line, beginning with a 72-hour forecast, then 48 and so on down, with confirmations or corrections given at least twice a day, and more often when required.

When these teletyped reports are received at the dispatching center, a "system mean" temperature is calculated for the day, this figured by averaging predicted highs and lows for the key points. The actual high reported at these locations is used when the mean is revised following an afternoon or special forecast. On the basis of this weather data, each day's deliveries to all customers, except those with fixed take, are plotted against the day's system mean.

This graphic operating information gives the pipe line its principal tool with which to arrive at daily estimated send-out. The information is relayed, by one pipe line at least, to dispatching stations by radio.

Operations are expected to be within two or three degrees at most of the esti-

(Continued on page 48)

American Gas Fundamentals

OUTLINE

Natural Gas

1. Geology
2. Drilling and Production

Manufactured Gases

1. Coke oven gas; producer gas, blue gas; carbureted water gas
2. Reformed gas
3. Hi-Btu oil gas

Transmission

1. Pipe lines
2. Corrosion and pipe protection
3. Compressor stations
4. Super compressibility
5. Hydrates and dehydration
6. Gas conditioning
7. Flow formulae
8. Orifice meter measurement

Gas Storage

Gas Distribution

1. System design and operation
2. Pressure regulation
3. Measurement and accounting

Gas Utilization

1. Combustion characteristics
2. Domestic
3. Commercial and industrial
4. Interchangeability

Conversion Practices

Management Problems and Policies

1. Corporate structure
2. Public utility regulation
3. Public relations

How to Use the Material

American Gas Fundamentals *is not intended as a training or service manual. It is a comprehensive compilation of basic gas facts to guide any gas utility employee toward a broader understanding of the industry as a whole. It is written in layman's language so that the technical fundamentals of every subject treated may be digested and understood by the non-technical reader.*

The series is designed to be removed from each current issue of American Gas Journal *and filed in a ring binder where it may be accumulated into a text book of permanent usefulness. Since the series will not run in sequence as outlined, material should be filed under the major subject head appearing in the upper right hand box at the head of each chapter.*

New subscribers to American Gas Journal *will be supplied free, upon request, with reprints of all previous chapters. Younger employees who may be required to serve in the armed forces will have put aside for them a full set of all texts that may be printed during their absence.*

Methods of Storing Gas

ANY description of the methods of storing gas, to be understandable, must be prefaced by a brief discussion of some of the particular considerations in gas distribution that make storage necessary. One thing that gas has in common with electricity, and wherein it differs from other common fuels, coal or oil, is that it cannot be stored on the consumer's premises. This means that it becomes the responsibility of the utility to see to it that the gas is available for delivery to the customer at any time, and in the amounts that he requires.

To be prepared to discharge this responsibility the utility must have not only adequate manufacturing capacity but must supplement this with storage capacity of some type. In the case of natural gas companies it is the pipe line capacity that must be reinforced with storage.

There is normally an hourly, daily and seasonal fluctuation in the demand for gas from a distribution system. The period of greatest demand is called a peak; it may be a peak hour, a peak day or a seasonal peak.

The reasons for peak demands are fairly obvious. For instance, families cook their meals at a certain time of the day, and the majority at about the same time every day. Since they can't store gas on their premises, they have to be able to take it from their service lines at the time, and in the volume that they require. This creates hourly peaks that on most gas systems occur in the morning, when breakfast is being prepared, and just ahead of dinner time in the evening. Water heating is a more uniformly distributed gas load than is cooking, but here, too, consumers' habits enter into the calculations that the gas utility has to make in assuring at all times an adequate supply for its customers. Monday, a conventional wash day in many communities, tends to create a daily water heating peak, upon which the hourly peak for cooking must be superimposed.

Seasonal Peaks

When house heating is added to the uses to which the customer puts his gas, we have still another and far more serious peak introduced, which is dependent almost entirely on the variations in the weather. It is obvious that it will take more heat, and consequently more fuel, to keep a house warm when the outdoors temperature is at zero, than it will when it is a balmy day of sixty degrees. On such a day the average home will consume more gas for heating than would be used in a month for cooking. This adds again to the daily peak, and to the hourly peak too, as the demand for heating gas goes up or down, hour by hour in almost exactly inverse ratio to the fall or rise in the outside temperature.

A manufactured gas plant or a natural gas pipe line could conceivably be built with big enough capacity so that no matter what the peak demand was, it could instantly be met. But this would be an extremely uneconomical way of doing it, since all of the investment in excess capacity would be wasted during the off-peak periods when only the nominal demand, or base load, as it is called, was required.

The gas storage problems of the industry have multiplied greatly since the early days when most of the business was concerned with manufactured gas, and the most important use of the gas was for lighting. Although even then some storage was required to take care of the extra morning and evening consumption that was in excess of plant capacity. As for natural gas, in early days, it was generally used close to the point of production, in Pennsylvania, New York, Ohio and West Virginia. Due to the close proximity of markets to the source, investment in oversize pipe lines could be kept relatively small, and peaks were met by drawing more gas from the wells.

By far the most important of the newer ways of storing gas in great volume is through the use of the underground reservoirs that have in times past been emptied of their natural gas supplies. This has opened up possibilities of storing billions of cubic feet at high pressures, and at low costs, compared to the few millions that can be accommodated by the biggest of above-ground holders.

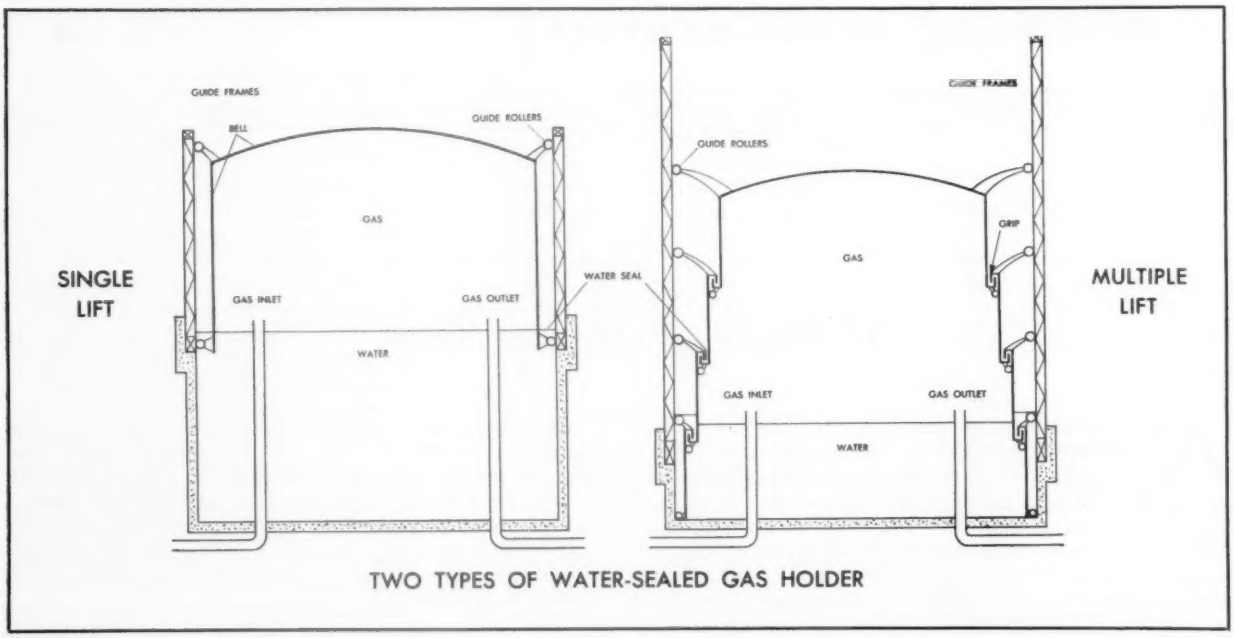
Types of Holders

Since storage in holders was the original, and remains a very important way of keeping gas in readiness for peaks, that manner will be described first.

Holder storage may be broken down into two general classifications: namely, low pressure and high pressure storage. Low pressure holders have one characteristic in common: gas is stored in them at a constant pressure, and the amount in storage is dependent on a change in the volume of the container. The pressure in low pressure storage and distribution is commonly expressed in inches of water column, which is in reality measurement in only fractions of a pound. A pressure of one pound per square inch is equal to 27.7 inches of water, therefore one inch of water column is only 1/27.7 of a pound, or a trifle over half an ounce.

Pressures used in low pressure holders and in low pressure distribution systems are generally below eight inches of water. The gas occupies the same cubical space, regardless of whether it is in the holder or in the system.

The commonest holder of the low pressure type is merely a huge inverted cup or bell with its open end sub-



TWO TYPES OF WATER-SEALED GAS HOLDER

merged in a tank of water, which keeps the gas from escaping around the bottom. As the holder is filled with gas, it floats up out of the water until it reaches maximum height, and the pressure on the gas is only that which is exerted by the weight of the floating cup or lift. This is the single lift holder.

It is interesting, and often surprising to the layman, to learn that in spite of the hundreds of tons of steel that go into a single lift, the pressure exerted on the gas is very small, usually no more than a few ounces per square inch.

To make it possible to build water-sealed holders of greater capacity without the expense and necessity of constructing enormous tanks, the multiple lift holder was developed. In principle it is the same as the single lift holder, but instead of only one section, it can have anywhere from two to five or more, so constructed that each section may telescope down inside the ones beneath it as the holder empties. The central section is the bell, closed at the top, which lifts the other sections. To maintain a seal between the sections, each is provided with a continuous gutter or cup around the inside of its rim, into which a grip on the section above fits. As each section is lifted from the tank, its cup carries enough water to seal the gas inside the section.

Suitable guide frames are necessary to support the holder against any lateral movement, or tilting. The sections are guided up and down by guide rollers that press out against the uprights of the guide frames.

Waterless Holders

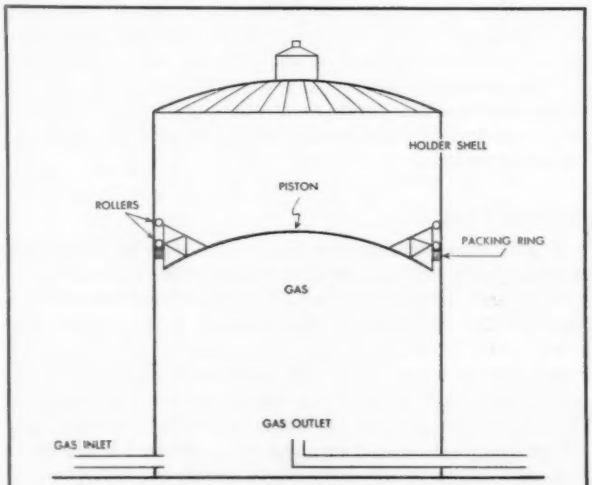
A newer type of low pressure holder is the waterless holder which was developed in Germany just prior to the first World War.

In the waterless holder the size of the outside shell remains constant, while the gas inside is confined by a piston that moves up and down, supported by the gas in the same general way that the lift of a water seal holder is supported.

The piston is guided as it moves up and down, by rollers which keep it in a horizontal position at all times. There are two types of seal used to keep the piston gas tight against the side walls of the holder, the dry seal and the tar seal. The one illustrated here is called a dry seal. It consists of a packing ring that is pressed out against the sides of the holder by means of counterweighted levers at regular and close intervals. In a tar seal holder the seal between the piston and the sides of the holder is kept tight by the weight of a small reservoir of tar that presses a rubbing plate against the smooth sides of the inside of the shell.

High Pressure Holders

High pressure storage is accomplished by the use of strong holders, tanks or containers of any kind that contain a fixed volume, and the amount of gas contained in them varies with the pressure. This is in accordance with



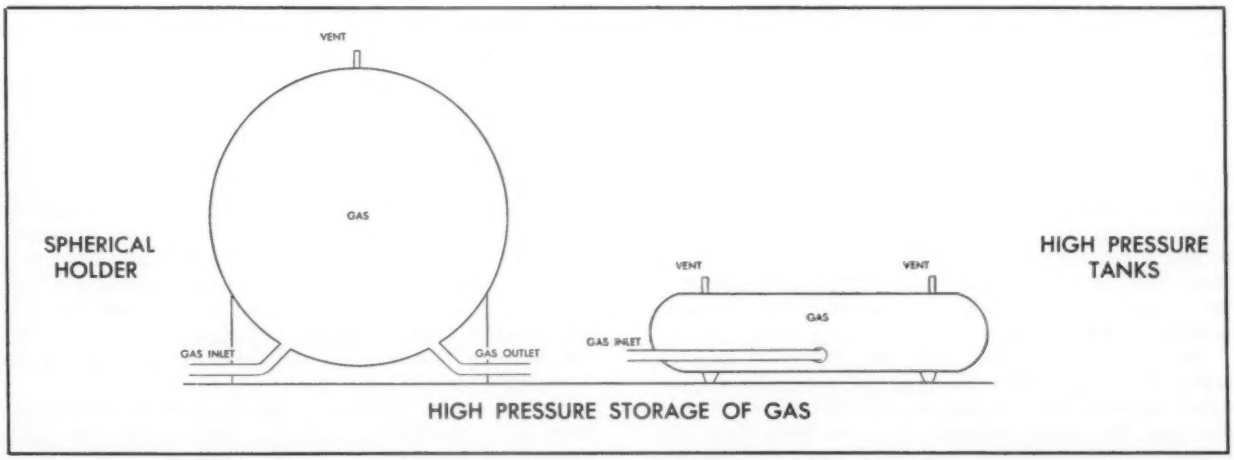
WATERLESS TYPE GAS HOLDER

Boyle's Law which states that when the temperature of a given weight of a perfect gas is held constant, the volume and absolute pressure vary inversely. For example: two cubic feet of gas at a certain absolute pressure will occupy just one cubic foot of space if the pressure is doubled, provided there is no change in temperature.

The operating pressures in holders of this type depend on design conditions and may run as high as 100 pounds per square inch. Most holders of this type, however, are designed for from 50 to 75 pounds operating pressure.

It can be computed on the basis of Boyle's Law that at 60 pounds pressure the holder contains five times as much gas as a low pressure holder of the same cubical capacity.

Since the pressure in this type of holder is very high compared to those in the distribution system, it can deliver gas without pumping, to intermediate as well as low pressure systems. An intermediate pressure system is generally regarded as one that operates at pressures of from two to 15 pounds.



HIGH PRESSURE STORAGE OF GAS

High pressure holders are practically always either cylinders with hemispherical ends, or perfect spheres. The cylinders may be mounted either vertically or horizontally, depending on such factors as the value of the land they are to occupy; the necessity of making them as inconspicuous as possible and the cost of foundations.

The spherical type of high pressure holder is known as the Hortonsphere, named after its designer, George T. Horton. The advantage claimed for the sphere over the cylindrical or bullet type of container is that the same pressures can be accommodated through the use of lighter steel than is required for the side walls of cylinders. In a cylinder it is necessary to make the walls approximately twice as thick as the hemispherical ends to withstand the internal pressure when the tanks are filled to their operating limit. By eliminating side walls, as is done when a perfect sphere is constructed, there is no necessity for the heavier sections of steel that would be required in their construction.

Supercompressed Storage

One of the newest developments in storing gas under pressures much higher than any ever used in conventional high pressure holders, is through the use of long narrow bottle-like containers, connected in batteries and often buried underground. The bottles are in reality nothing but 40 foot long sections of heavy wall 24-inch pipe, closed by hemispherical ends and tapped for pipe connections. They have enormous capacities due to their high operating pressures, for over 200 cubic feet of gas at atmospheric pressure can be squeezed into one cubic foot of space at 2240 pounds pressure in one of these bottles.

The amount of gas that can be stored at these pressures is much greater than would be indicated by the application of Boyle's Law, because gases such as natural gas have been found to be more compressible than the law states. This deviation from the law which is known as the supercompressibility of gas reaches its maximum amount at pressures of around 2000 pounds.

An interesting variation of the conventional methods of storing natural gas under pressure is through first liquefying it, by compression and cooling in several stages until it is reduced to a temperature of about 260 degrees below zero F. At this low temperature and in a liquid state, gas occupies a space of only about one six hundredths of its volume at normal temperatures and pressures. In the only plant of this kind to be put into commercial operation, the liquid gas was stored in three spherical and one cylindrical tank, of special nickel alloy steel designed to resist the intense cold, and insulated with three feet of cork between the inner and outer shells. The experiment came to a sudden and dramatic end, however, when after over three years of operation one of the tanks failed, causing a fire and explosion that levelled the plant. This happened in 1944, and while there has been discussion among engineers of reviving the process, it is at the present time viewed with misgivings by the industry.

Underground Storage

To the extent that gas reserves in the ground are in storage until they are drawn upon, it might be said that practically all natural gas is in underground storage. But the gas reserves are at the opposite end of the pipe line from the consuming market, and consequently are not thought of as stored in the sense that gas utilities use the term.

Many years ago it was found that gas could be taken from the ground in one area and placed back in depleted wells in another, thus providing storage nearer the point of large consumption. Today numerous depleted fields in

the midwest and Appalachian areas are being used to store gas underground.

The storage field is not a large underground vault or cavern. It is rather a large area of sandstone or other porous rock (such as was described in Natural Gas, Geology, Chapter 1 in American Gas Fundamentals) which once produced gas. The gas forced into the ground creeps out through the formation and fills up the spaces in the porous sands just as they were originally full when the first producing well was drilled into the field. Since the caprock covering the producing sands had held the original gas in the formation for millions of years prior to the first discovery drilling, it is obvious that there is little fear of gas escaping from the underground pools.

As has been mentioned, underground storage, compared to even the biggest capacity holder storage, represents tremendous volumes. Some systems have enough gas stored in the ground to allow them to operate for days at a time without drawing on their pipe line supply. The biggest gas holder built has a capacity of only 15 million cubic feet, whereas underground reservoirs now being used by one gas system alone are estimated to hold upwards of 125 billion feet when they are completely filled.

The great advantage of underground storage, aside from its almost unlimited capacity, is the low cost compared to building and maintaining holders of any kind. The investment in underground storage is confined largely to two items, the cost of the compressors needed to inject it into the field, and the cost of the gas that must be put in and left as a cushion to maintain the necessary underground pressures.

The savings to the gas utility are effected through its ability to buy gas from the pipe line company in practically uniform amounts day in and day out over the entire year. By taking capacity deliveries from their suppliers the year round they are able to minimize the pipe line companies' investment in transmission facilities, and this in turn means they are able to buy gas at lower prices. The Columbia Gas System, Inc., largest operators of underground storage, have $34 million invested in this type storage, out of which they may have to take as high as 842 million cubic feet in a single day during the winter season. To build pipe lines from the Appalachian area to Texas to deliver this amount of gas in one day would cost several hundred million dollars.

The limiting aspect of underground storage is that it is generally available only in areas from which natural gas has been taken out of the ground at some previous time.

The equipment necessary to place gas in underground storage consists essentially of high pressure compressors, which may be driven by natural gas, or other fuels. The size and capacities of the compressors are dictated by the amount of gas that must be handled at the peak of input, and the maximum pressures that are to be built up. In storing gas underground it is the practice to plan to build up an ultimate pressure equal to that which was encountered in the field when it first started to produce natural gas.

The only pressure needed ordinarily to take gas from the underground storage is that which has been built up by the compressors as they fill the sands during the summer and offpeak seasons. It is sometimes necessary to install dehydration equipment to remove water that may have been picked up by the gas during its confinement underground. The principles and the apparatus in use for this purpose will be described in a subsequent chapter of Fundamentals on Natural Gas Conditioning.

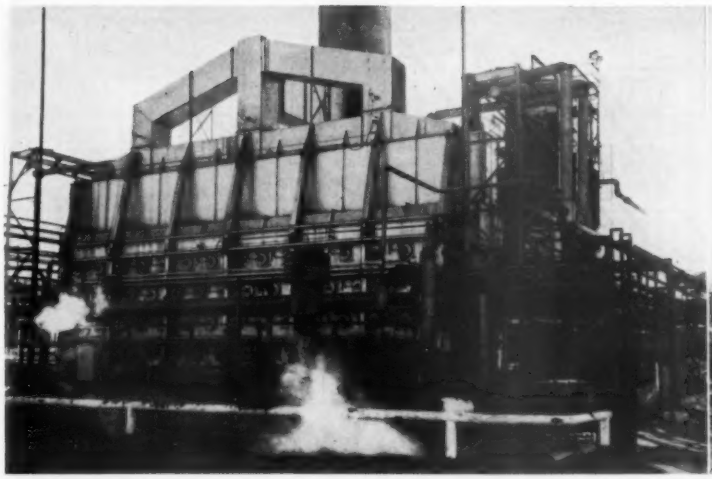
With all of these various types of storage available, the question the gas utility must consider is what type or types should be used and where they should be located.

Holders in Use

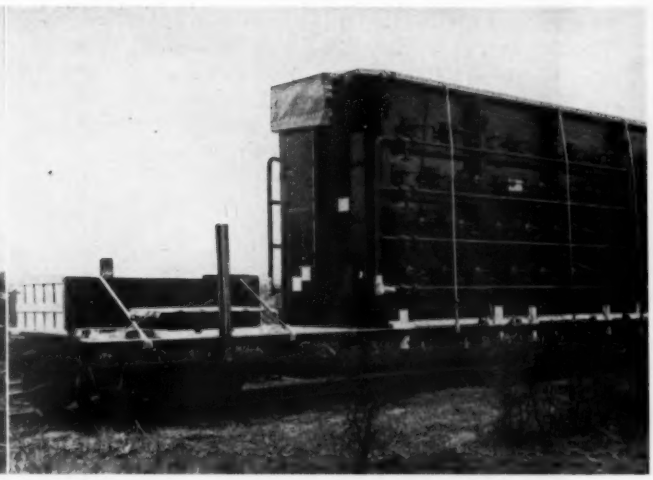
In general, low pressure holders are located at a manufactured gas plant, and spotted in a few strategic locations along the distribution system. The holder at the plant is there for the purpose of making possible the continuous operation of the gas making machinery at the most economical rate of production. It is essential in solving the problems of hourly peaks. When the rate of production exceeds the hourly demand, the excess gas made is passed into the holder; when demand exceeds production, gas is taken from the holder to supply the difference. Conventional low pressure water seal holders may be observed to be filled to the limit of their capacity early in the morning. Standard operating practice is to have holders completely filled by 6 A.M.

Sometimes the demand for gas in different districts or areas of a distribution system is greater than the pipe lines from the plant can accommodate. For this reason holders of one type or the other are often placed along the distribution lines some distance from the plant. Their function there is the same as that of those located at the gas making site. During slack periods the lines can be operated at capacity, and the excess of gas sent out stored in the more remote holders. When peaks occur, and the flow of gas direct from the plant becomes inadequate, the district holders automatically begin to feed back and take up the difference between production and demand.

Both the conventional low pressure and so-called high pressure holders are essential auxiliaries of the manufactured gas industry, although they can be used to advantage with natural gas in caring for hourly peaks. Underground storage and the new high pressure bottled type of storage are essential developments of natural gas and serve that branch of the industry almost exclusively.



A radiant gas-fired petroleum heater in operation.



A prefabricated petroleum heater, ready for erection at refinery site.

Gas Radiant Heaters Revive Interest In Thermal Cracking

by Kurt W. Fleischer

Manager, Refinery Division, Selas Corporation of America, Philadelphia

THE application of advanced gas combustion technologies to petroleum cracking has returned the attention of the refining industry, with considerable emphasis, to thermal cracking. This gas industry development is announced within months of the widely published prediction that catalytic cracking would replace thermal cracking "almost completely by 1960 . . . to meet quality requirements."

Radiant heaters for the petroleum refining industry are meeting and surpassing current quality requirements, thereby establishing high regard for gas as a fuel and for gas-designed processing equipment.

Basically, the refining industry's problem in thermal cracking was to apply the required amount of heat to the continuous oil stream as it passed through tubular heaters, also to apply that heat uniformly and in a minimum time. The shape of the time-temperature curve determines petroleum product quality; meeting the specified curve with heater performance will result in the specified product quality.

Conventional petroleum heaters are characteristically unable to produce the specified shape of the time-temperature curve largely because the application of heat to the tube coil is not uniform and accordingly the heat input to the petroleum stream is not uniform.

The solution—and the return of emphasis to thermal cracking—was developed in a gas fired radiant petroleum heater with heating characteristics that provide for matching the steepest time-temperature curve. Heat input is uniform along the length and around the circumference of the tubes. The input is under precise control so that it can be varied to meet the differing but specific requirements of different petroleum stocks. Also, the input can be at different degrees of intensity in the sections of the tube coil, again meeting the refinery engineers' time—temperature specifications.

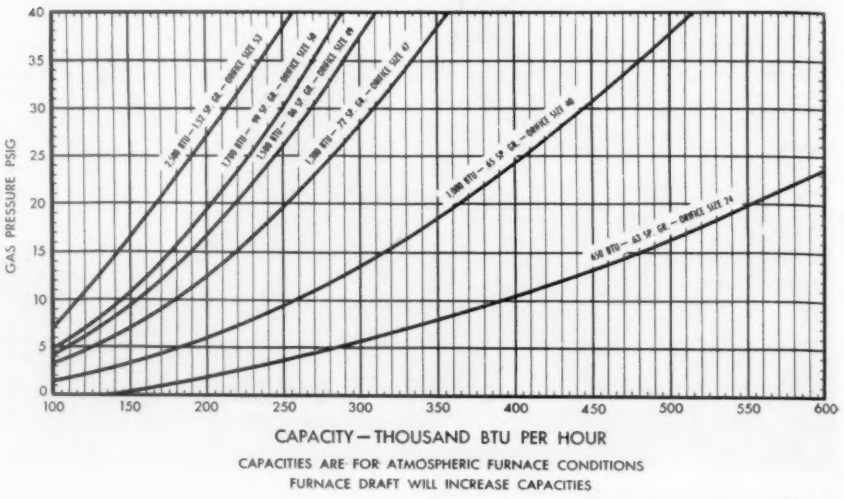
Together with the solution to the heating problem itself, the new radiant petroleum heaters afford important economic advantages over conventional heaters.

They are prefabricated and shipped in

Interior view of radiant petroleum heater before installing the tubes.

two sections which are erected and assembled ready for refinery piping connections in about eight hours. This is to be compared with weeks-long construction periods for conventional heaters.

Fewer tubes are required and the virtual exclusion of excess air from the heater atmosphere alleviates oxidation of the external tube surface, thereby lengthening tube life substantially.



Capacity chart of the new inspirating type radiant ceramic gas burners.

Petroleum stocks that could not be cracked economically because of coil coking can be processed successfully in the new radiant heaters.

Cracking severity, octane number and the conversion are increased appreciably, resulting in higher daily production volume.

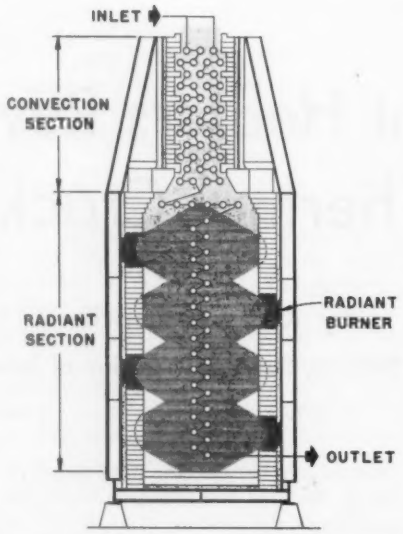
These are operating conditions that were not previously attainable in commercial thermal cracking. The petroleum industry, distinguished for its awareness and utilization of advanced processing methods, has adopted the new radiant gas heaters with significant enthusiasm.

The heart of the new petroleum heater is its radiant ceramic burner with a new and improved venturi-type inspirator. The entire fuel-air stream enters through the inspirator to provide an accurately proportioned mixture, with no need for mechanical devices in the operation of the burners.

The gas-air mixture is burned completely in high temperature-resistant refractory cups and burner tips. Conventional temperature control devices on the fuel gas line maintain completely automatic heater operation without manual operation or adjustments to meet changes in furnace loading.

The combined gas and air stream is mixed in the venturi and burner tip passages. The mixture burns as it leaves the many small ports of the burner tip and sweeps radially across the burner cup surface. The inner contour of the cup is shaped so that its surface is always "washed" by hot combustion products, regardless of the operating rate.

The refractory cup surface is heated to incandescence by the high velocity combustion products. Combustion is completed well within the cup and only incandescent products of combustion can be seen a few inches beyond the cup. Complete combustion within the burner cup prevents delayed and uncontrolled combustion around the heater tubes.



Drawing of the radiant petroleum heater, showing the relationship of the tube coil to the burners and the petroleum flow through the coil.

The high temperature of the refractory cup permits the heat of the gas combustion to radiate directly and uniformly to the heater tubes.

This uniform distribution permits the operation of the tubes at radiant heat transfer rates as high as 30,000 Btu per square foot of tube surface per hour. This is in contrast to conventional heaters, with non-uniform heat distribution and relatively little tube surface exposed to direct radiation, where the apparent maximum average radiant heat transfer rate is 12,000 Btu.

C. C. Tate, refining department manager, Phillips Petroleum Co., while addressing the Western Petroleum Refiners Association early this month under the title of "A New Development in Radiant Heating for the Petroleum Industry," said:

"Based on present performance, this type of radiant heater has tremendous possibilities for both the large and small refiner, not only for thermal cracking and visbreaking gas oils, cycle oils and heavy oils, but also for the thermal destruction of light hydrocarbons such as ethane, propane or other applications where short residence times *(periods during which petroleum is within the tube coil)* are essential."

Clearly, such an authoritative statement constitutes a notable compliment for gas and heat processing equipment designed to utilize gas with marked technological and economic advantages.

Cleveland Conference Planned For Research & Utilization

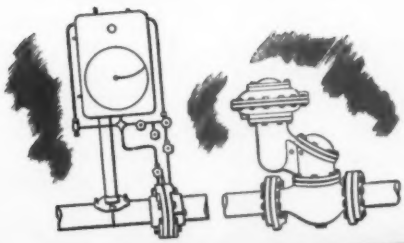
The annual Research and Utilization Conference sponsored by the American Gas Association will be held May 24 and 25 at the Hotel Statler, Cleveland, it has been announced recently by R. J. Rutherford, President, Worcester Gas Light Co., and chairman, AGA committee on domestic gas research. Edward J. Nelson, Rochester Gas & Electric Corp., will serve as chairman of the Cleveland conference.

A technical display that interprets some of the basic technical advances being made in gas appliances will be a feature of the conference.

The AGA laboratories will be open to visitors on Wednesday, May 23, the day before the conference. Members of the laboratories' staff will be available for consultation on research and utilization subjects.

Subjects scheduled for the two-day conference cover venting gas appliances, operating characteristics of new gas refrigerators, burner flexibility, automatic clothes dryers, service calls, all-year gas air conditioning, gas appliance insulation, and the field tests on gas range ignition. Technical talent from gas utility companies, gas appliance manufacturers, engineering, research, and educational institutions has been gathered to lead the conference.

SOME EASTERN SEABOARD REGIONS NOW RECEIVING NATURAL GAS THROUGH AMERICAN METER COMPANY EQUIPMENT



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12. Temperature and Pressure Recorders

Guide Covering Changeover Practices Summarizes Experiences

by J. V. Turpish, K. J. Burnett, D. L. Drake

THIS material is confined solely to the customers' service aspects of conversion from manufactured gas to straight natural gas.

The committee gives credit and thanks to the following companies for their help in compiling the information:

Central Hudson Gas & Electric Corporation; Conversions & Surveys Inc.

Office—Communication

Provide one company man as co-ordinator. He must be relieved of all other duties and must recognize the fact that he must think, eat and sleep nothing but conversion until the job is finished.

Provide additional telephone facilities and personnel at conversion headquarters. Conversion headquarters should, if possible, be your regular customers' service department and additional telephones should consist of new trunk lines of the *same telephone number series* as your regular service department telephone number. Additional personnel probably can be borrowed from other departments. This is advisable as these people are already familiar with overall company policy. The conversion job will probably result in receipt of one additional call per meter sometime during the job. Since conversions vary widely as to scheduled speed of completion, it is impossible to express this increase in calls in terms of percentages of regular calls.

Provide office space for the contractor. If at all possible, this office space should be close to the conversion headquarters. This speeds up communication between these two main agencies.

Provide storeroom space for conversion material, separate from the regular storeroom.

Provide for proper radio communication between office and job.

Situations arise during the best conversion that require immediate communication in addition to the time saving feature of radio communication for dispatching routine calls.

The New York & Richmond Gas Co. used six mobile telephone company units for a 40,000 meter conversion.

Your distribution department may a'so find them valuable when turning on and purging any critical districts.

Paper presented at AGA Distribution, Motor Vehicles, and Corrosion Conference, Memphis, April 1951.

Mr. Turpish is with New York and Richmond Gas Co., Staten Island, N. Y.

Mr. Burnett is with United Gas and Fuel Co. of Hamilton, Ltd., Hamilton, Ont.

Mr. Drake is with Consolidated Gas Electric Light & Power Co., Baltimore.

Inspection—Instruction

Provide company inspectors for the conversion. In general, one company inspector for each 25 or 30 adjusters would give about a 25 per cent inspection of the whole job. House heating should be inspected 100 per cent.

Provide school space for the contractor's adjusters and your own men. The contractor will probably supply instructors for this school or if you have a staff of instructors in your company which has been trained beforehand in conversion procedure, you may want to conduct the school yourself. Bear in mind that your contractor has a number of experienced men but he will probably hire a number of new men locally. Nobody can come into your territory and perform to your satisfaction unless you instruct them on your own local policies and conditions. What may be right in City A may be wrong in City B and vice versa. Only you know this and you must tell them. In order to accomplish this, one or more conferences should be held between your co-ordinator, your instructors, your inspectors and the contractor's instructors.

Your own men should be sold on the reason for the conversion and the advantages of the new gas. Regardless of what gas we mention it has its good and its bad points. Provide a quantity of the new gas for class room purposes.

It is of paramount importance that you make a thorough pre-survey of your commercial and industrial accounts to determine, with the greatest possible degree of accuracy, what equipment can be properly converted and what must be replaced.

Critical jobs which require high intensity of heat application in limited space, such as in glass factories, those where gas flames must burn in turbulent atmospheres, such as in can factories, should be thoroughly investigated, bearing in mind the flame temperature and flame propagation characteristics of both old and new gases.

Determine with a reasonable degree of accuracy the number and type of domestic appliances, particularly water heaters and house heaters.

Note:—One company has an automatic appliance file which was originally started for warranty purposes. This was an invaluable aid on this.

Your own service men will also be able to give you quite a little general information.

Request from management the chance to advise on company policy on advertising the conversion. The usual newspaper maps, gas bill stuffers, individual letters to customers, follow up letters to customers and door knob hangers in addition to the usual news items are, in general, sufficient.

Caution: Do not try to be too explicit. Only give the customer the information he needs. Extra talk on your part results in extra talk on the customer's part.

You know what you are talking about. In general the customer makes assumptions, based on facts that he reads and passes on his assumptions as fact.

Additional Caution: Do not allow anybody under your control to use the statement "Natural gas is twice as hot."

Determine your "Can't Get In" policy. Your final decision on this will depend on your percentage of services equipped with curb cocks, what percentage of your customers are in the business couple group, and what type of housing they occupy, whether meters are acces-

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A gas range for every need! Empire's complete line of gas ranges is designed to meet each of your customers individual needs. Glide out broilers, single or double ovens, 4 or 6 burners, visual doors, oversize ovens and many other modern features to provide volume sales, and higher customer satisfaction.

EMPIRE STOVE COMPANY

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WORLD'S LARGEST MANUFACTURER OF *Gas* FLOOR FURNACES

Table 1—Comparative Meter Timing for Determining Input

Meter time 2 cu. ft. in. Min.	Sec.	Meter time 4 cu. ft. in. Min.	Sec.	CFH Man. Gas —525 Btu	CFH Nat. Gas 1000 Btu	Meter time 2 cu. ft. in. Min.	Sec.
2	0	4	0	60	31.5	3	49
1	35	3	10	70	26.7	3	16
1	30	3	0	80	42.0	2	52
1	20	2	40	90	47.3	2	33
1	12	2	24	100	52.5	2	17
1	5	2	11	110	57.8	2	5
1	0	2	0	120	63.0	1	55
	55	1	51	130	68.2	1	46
	51	1	43	140	73.5	1	38
	48	1	36	150	78.8	1	32
	47	1	30	160	84.0	1	26
	42	1	25	170	89.3	1	21
	40	1	20	180	94.6	1	16
	38	1	16	190	100.0	1	12
	36	1	12	200	105.0	1	9
	34	1	9	210	110.0	1	6
	33	1	6	220	115.5	1	2
	31	1	3	230	121.0	1	0
	30	1	0	240	126.0		57
	29		58	250	131.5		55

Table 2—Orifice Sizes for 1000 Btu Nat. Gas Spg. .7 Cu. Ft. Per Hour

Drill Sizes	C.F.H. @ 3" W. C.	C.F.H. @ 5" W. C.	C.F.H. @ 7" W. C.
41	19.8	25.7	30.6
31	30.9	40.2	48.0
29	39.7	51.6	61.4
23	51.0	65.5	79.0
19	59.0	76.0	90.0
15	70.0	88.0	107.0
10	80.0	104.0	123.0
5	91.0	117.0	139.0
3	97.5	126.0	149.0
2	105.0	134.5	161.0
1	111.5	144.0	170.0

Table 3

Orifice for Man. Gas @ 525 Btu .45 G. 5" w.c. Drill Size		Orifice for Nat. Gas @ 1000 Btu .75 G. 5" w.c. Drill Size
No. 1	=	No. 11
No. 2	=	No. 13
No. 3	=	No. 15
No. 5	=	No. 17
No. 10	=	No. 20
No. 15	=	No. 25
No. 19	=	No. 28

sible without entering living quarters, what your legal department thinks of the hiring of locksmiths to gain entry to locked buildings, and whether your conversion is to take place in winter when nobody is away on vacation.

Bear in mind the necessity of digging up and cutting off services if all other efforts to discontinue service fail.

Quite often other people in the neighborhood can inform you as to the whereabouts of relatives of the occupants on the CGI who can help you to get in.

Experience on this problem indicates that as soon as people find out that you really do cut off a few in the early stages of the conversion, the later ones become more cooperative.

Your contractor will probably turn back to you for final disposition all CGI's the first day in each district by about 10:30 o'clock on that morning. The experience of the New York & Richmond Gas Co. showed the number of these CGI's to be an average of 3 per cent of the meters in each district. The experience of Central Hudson Gas and Electric Corp. showed the number of these CGI's to be 8¼ per cent. The experience of Conversions and Surveys Inc. is that this figure will vary from 3 per cent to 5 per cent. You should arrange for a sufficient number of your own men to cover these jobs again, within a four hour period, taking time to get information from neighbors as to the whereabouts of the occupants of the locked premises.

Each time one of these men exhausts all possibilities of gaining entrance to a premises, he should report back to his supervisor. This supervisor should then satisfy himself through the customers' accounting department that there is actually an open account at that address before turning the job over to the distribution department for a cut off of the service. The necessity for this check with the customers' accounting department is because from the time that the original conversion orders are made out by them, until the conversion date, there will be some normal turn over on accounts and it may be possible that you are getting some CGI's on locked accounts.

Appliance Condemnation

Determine policy on appliance condemnations. This will be flavored to a great degree by your existing policy, your local city ordinances and your legal department's opinion.

Things you should think about are unvented water heaters, other unvented automatic appliances, hose connected appliances, appliances in such bad condition that they are hazardous, bad house piping.

Determine policy on special time appointments requested by individual customers.

Your top management should be made aware of the job disruption caused by this item and that it should be held to an absolute minimum. The foregoing, of course, does not apply to commercial or industrial customers who would be seriously handicapped, unless you fit their conversion in as well as possible with their work schedules.

Determination of Distribution Pressure

The co-ordinator should advise the proper people in his company that gas appliances, in general, will operate most satisfactorily if manifold pressures are 5" wc pressure or better. Below this point is a quite often hard to get proper primary air inspiration.

Provide detailed job specifications for each type and, if possible, for each make of appliance. The company utilization engineer, the company customers' service supervisors and the contractor's utilization engineer should work very closely with each other on this. Space and time limitations and the great diversity of appliances and change over conditions make it impossible to cover this subject completely here, but the following are a few suggestions which all should bear in mind when changing from a fast burning manufactured gas to a slower burning natural gas.

1—Ranges—the most important load you have.

All atmospheric burner port areas will have to be enlarged. This is easy on cast iron and cast white metal drilled port burners. The same thing should be done on drilled port enamelled cast iron range top burners, but you should give prior consideration to the question of enamel chippage and consequent customer complaint. If you decide against drilling these burners during conversion, you probably will do so later, on customer complaint of improper ignition and streaming.

There are some ranges that are equipped with burners other than drilled port types. The most common of these are slotted port and those with cast partitions between ports. The manufacturer's engineering department should be consulted on these.

In spite of the fact that you have drilled all top burner ports, you still will have some streaming troubles on table top ranges, caused by leakage of oven products of combustion into the top burner boxes.

To overcome this, you will have to do whatever you can with the particular range, to divert these oven products away from the top burners.

As a matter of habit conversion men refer to this caulking or sealing or stripping as "insulating." This is an ill advised expression, as the customer who is told that her range must be "insulated" to work properly, thinks in terms of her own definition of "insulation" and you will have trouble explaining this misunderstanding.

(Continued on page 51)

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The distinctive, "Out-Of-This-World" ROPER beauty usually has first call on the prospect's attention. But beyond that, the exclusive features, the operating convenience, the easy cleanliness, the superb performance come into the picture as important reasons for more and more housewives saying, "I want a new ROPER in my kitchen."

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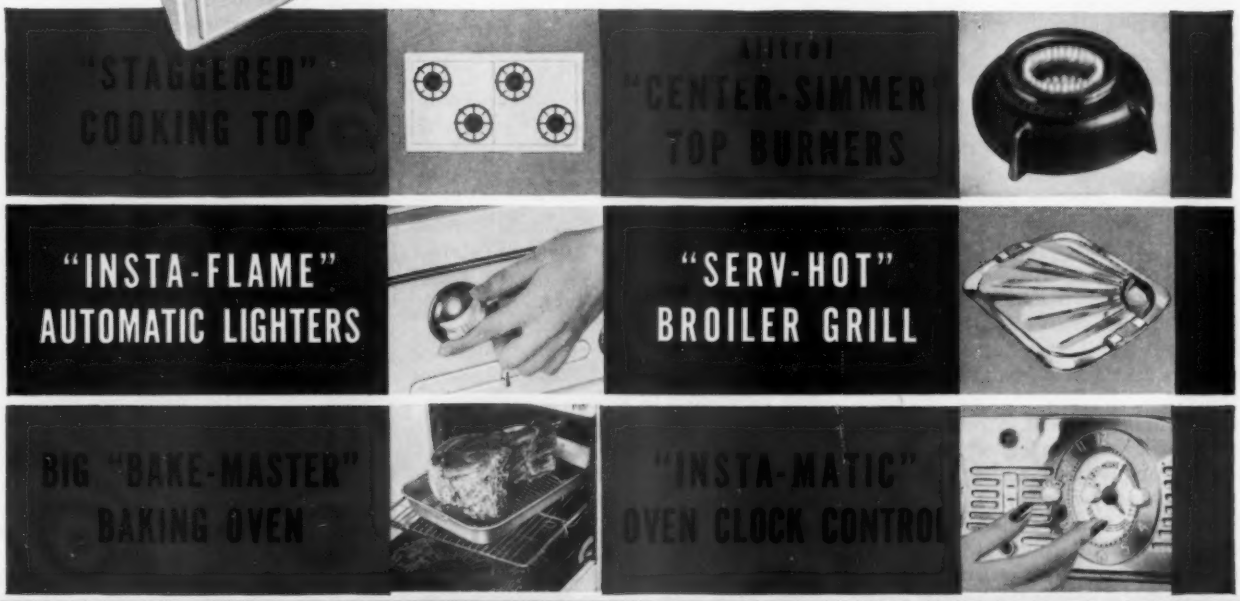

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Index of Yields : Selected Utilities Stocks

	Apr. 1951	Mar. 1951	Feb. 1951	Jan. 1951	Dec. 1950	Nov. 1950	Oct. 1950	Sept. 1950	Aug. 1950	July 1950	June 1950	May 1950
Natural Gas Transmission Companies	5.22%	5.38%	5.31%	5.36%	5.97%	5.62%	5.19%	5.71%	5.46%	5.76%	4.86%	4.70%
Natural Gas Transmission & Distribution Companies	5.43	5.35	5.31	5.47	5.67	5.46	5.40	5.61	5.71	5.79	5.29	5.11
Manufactured & Mixed Gas Companies	5.23	5.22	5.21	5.22	5.56	5.46	5.24	5.52	5.55	5.76	4.98	4.66
Class "A" Electric Companies	5.52	5.49	5.65	5.62	6.19	6.03	5.56	5.67	5.59	5.64	4.94	5.13
Class "B" Electric Companies	5.72	5.66	5.78	5.80	6.38	6.06	5.99	6.06	6.35	6.41	5.58	5.30

Method of Compiling Index of Yields

This is a straight arithmetical index of comparative yields obtainable on a selected group of gas and electric utility industry common stocks.

The companies comprising this index have been selected by the AMERICAN GAS JOURNAL as providing a representative cross-section of each industry, from the standpoint of geographical diversification and of the relative importance of the individual companies in their areas.

No effort has been made to weight the average to give effect to changes in capitalization or in dividend rates because the yields afforded on the issues reflect such changes. The index is designed to show the rate of return and not necessarily market movements on the stocks comprising it.

The companies used in compiling this index are:

Natural Gas Transmission Companies: El Paso Natural Gas Co.; Northern Natural Gas Co.; Panhandle Eastern Pipe Line Co.; Southern Natural Gas Co.; Tennessee Gas Transmission Co.

Natural Gas Transmission and Distribution Companies: Columbia Gas System, Inc.; Consolidated Natural Gas Co.; Lone Star Gas Co.; Oklahoma Natural Gas Co.; Pacific Lighting Corp.

Manufactured and Mixed Gas Companies: Bridgeport Gas Light Co.; Brooklyn Union Gas Co.; United Gas Improvement Co.; Peoples Gas Light & Coke Co.

Class "A" Electric Companies: Boston Edison Co.; Commonwealth Edison Co.; Houston Lighting & Power Co.; Southern California Edison Co., Ltd.

Class "B" Electric Companies: Dayton Power & Light Co.; Hartford Electric Light Co.; Pennsylvania Power & Light Co.; Public Service Co. of Colorado; San Diego Gas & Electric Co.

John F. Falvey

THE bond market has not been able to shed its jitters of recent weeks. This is shown in the renewed weakness in government securities.

One thing is clear, however. Corporate management will have to reconcile itself to paying considerably more for new financing money than it originally had estimated.

The coupon rate on highest grade corporate obligations now is firmly fixed at 3¼ per cent, against the 2⅞ per cent which had prevailed at the start of the year.

Despite the fairly substantial premiums above par which have been bid for the new issues by the underwriting firms, the cost of the new money to the utilities is running in the neighborhood of 3.18 per cent to companies whose bonds have the highest credit rating, about 3.3 per cent for soundly rated obligations and 3.50 per cent and higher for issues classified as just short of sound calibre.

Refundings—except in rate instances —now seem to be a matter of history, with the supply of money tightening.

An increasing number of utility managements are falling back on short term bank loans to tide them over the bulk of the year's construction needs. While much of this is due to the normal desire to ascertain just how much financing will have to be done, it reflects in some cases a hope that improvement in the over-all investment picture may permit somewhat better interest cost some months ahead than now is possible.

The net result may be a scramble for new money and disappointment for some of the managements in question.

Two significant factors about the financing done to date this year are the sharply increasing proportion of common stock to the total and the greater number of new issues which have been finding their way to purchasers through negotiated sale as against competitive bidding. Only a little more than 25 per cent of all financing in March was competitive, compared with better than three-fourths of the total in each of the first two months of this year.

Common stock financing reached 40 per cent of the total in March, or a level two-fifths above the 1950 rate and double the percentage of equity financing done in 1949.

In essaying sale of increasing amounts of new common stock the utilities have had the benefit of a stable market, which during the past several weeks has stayed constant at a point where all utility stocks as a group have been affording a yield return of 6.3 per cent.

Investor demand for stocks currently is being stimulated by the favorable earnings experience of industrial companies. Even with higher taxes, corporate profits for early months of this year have confounded the forecasters by staying close to the record high level of the closing months of 1950.

The reasons for this are not hard to find: Manufacturers of consumer goods items have been able to hold output on a continued high plane in the face of rising military production, and well-maintained commodity prices have saved industry from the anticipated need for absorbing losses on its large volume of inventories.

Conversely, however, inventory profits—which were a lucrative source of income for many companies in 1950—will be lacking this year due to price controls. But while wages and other costs are rising, and taxes also appear headed for a further hike some months hence, close observers of the corporate scene look for earnings in 1951 no worse than probably 10 per cent below the very high level of 1950. This would mean the third highest average of corporate profits on record or sufficient to permit a dividend payout close to, if not equalling, the $9 billion of distributions to stockholders in 1950.

Manufacturers Wants to Build 172 miles of line in Pa.

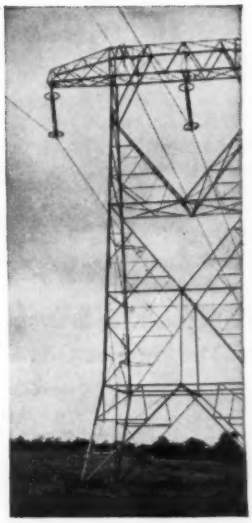
The Manufacturers Light and Heat Co., Pittsburgh, has filed application with the Federal Power Commission to construct 172 miles of pipe line to deliver gas from producing fields in Clinton County, Pa., into the Pittsburgh area.

Proposed project, estimated to cost $9,613,000, would include 16, 20, and 24-inch pipe, together with measuring stations and river crossings, extending from a point in Gallagher Township in Clinton County to a point northwest of Cannonsburg in Washington County, Pa.

The company estimates that the theoretical maximum capacity of the proposed line would be approximately 105 million cu. ft. per day.

Manufacturers' application asks FPC either to authorize the proposed construction or to find that the construction is not within the commisison's jurisdiction.

Panorama OF PROGRESS



A few examples of EBASCO's extensive, world-wide engineering and construction activities are pictured here. Industrial plants—steam electric stations—hydro electric projects—natural gas pipelines—each built quickly and efficiently with the aid of competent EBASCO teamwork.

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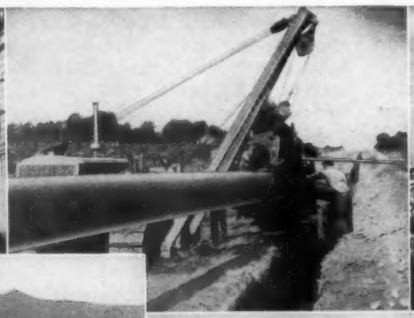

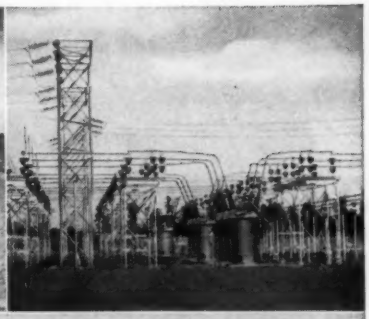

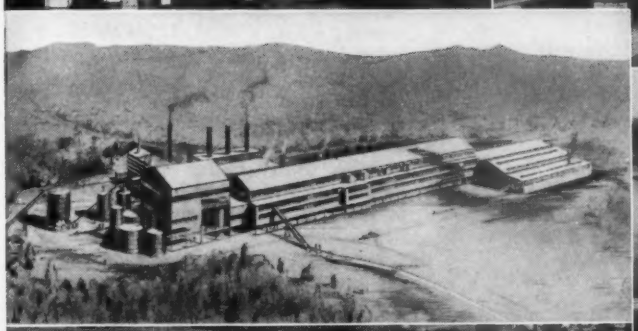

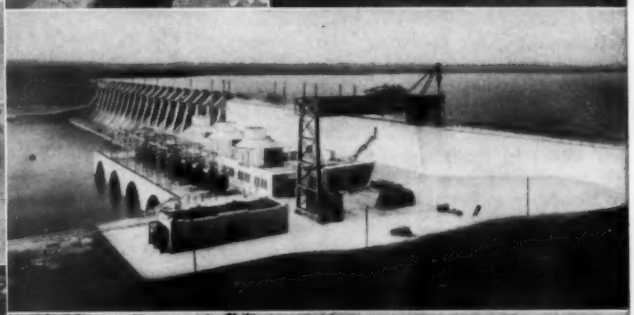

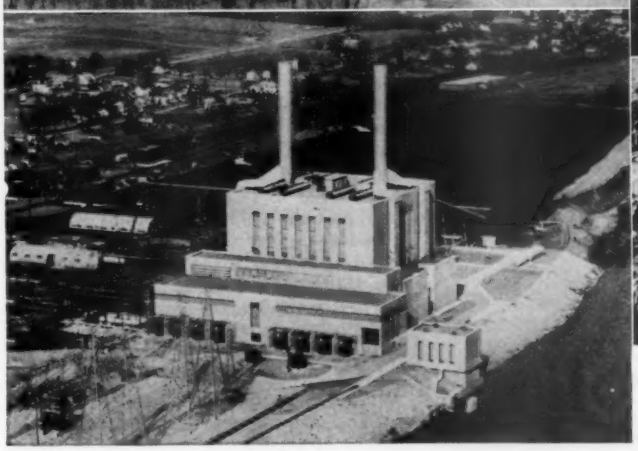

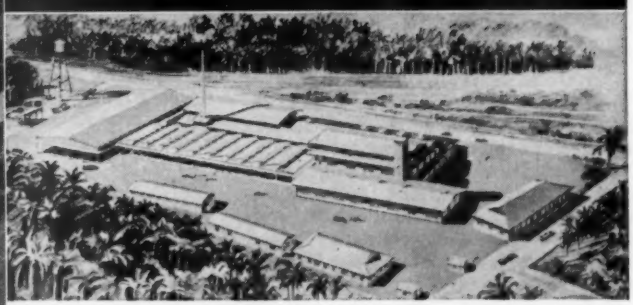

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			Traffic

News of the Gas Industry

Cassidy Is Public Relations Director of Peoples Gas

C. G. Cassidy

Clayton G. Cassidy has been named director of public relations and advertising of The Peoples Gas Light and Coke Co., Chicago. He has been advertising manager of the company for seventeen years.

In this capacity, he heads a new department which includes three managers, each responsible for a specialized activity. Raymond W. Fenton, formerly assistant advertising manager, has been appointed manager of advertising; Daniel H. Mowat, manager of press relations; and Charles J. Morse, manager of publications.

Mr. Cassidy has been in Chicago since 1929, having been associated with other utilities in the area prior to joining Peoples Gas in 1934. He also has been active as an advertising and public utilities consultant. Prior to 1929 he was for some years in newspaper work serving with several middle western papers as staff correspondent, city editor and sports editor.

John Stilwell Retires as VP Of Consolidated Edison

Col. John Stilwell, vice-president of Consolidated Edison Co. of New York, retired April 1 after 42 years of service in that company and its predecessors.

Colonel Stilwell is known nationally as an earnest advocate of safety education in industry and has served as President of the American Museum of Safety, the Greater New York Safety Council and of the National Safety Council.

In the years that followed his first job with Consolidated Gas Co., as draftsman in 1909, Colonel Stilwell was responsible for the introduction in that company of modern punch-card payroll systems and the changeover from horse-drawn to motor transport. As Consolidated Edison vice-president, his jurisdiction included the transportation, payroll, insurance, real estate and resuscitation departments. He has also been chairman of Con Edison System's central safety committee since its inception in 1944.

Miller and Nichols Promoted By Rochester Gas & Elec.

The Rochester Gas and Electric Corp. has announced the election of two new officers, Paul J. W. Miller, secretary, and Harold W. Nichols, treasurer.

Mr. Miller has been serving as assistant secretary and Mr. Nichols as assistant treasurer and their promotions followed the retirement on March 31 of Frederick H. Patterson, secretary-treasurer, who retired after 41 years of service with the utility. Mr. Patterson had been in office for more than 38 years, secretary for more than 18 years and treasurer for 10 years.

Mr. Miller has been with the Rochester Co. for 37 years, filling various posts in the auditing and accounting departments.

Mr. Nichols entered the utility accounting field 28 years ago with the New York State Electric and Gas Corp. of Ithaca, N. Y. He joined the Rochester company in 1930 as auditor and has served as assistant treasurer since 1941.

It was also announced that Harold S. Weatherby, in addition to retaining his title of assistant secretary, will assume the duties of superintendent of general accounting.

Ohio Fuel Asks FPC to Approve 61 Miles of Lines in Ohio

The Ohio Fuel Co., Columbus, has asked the Federal Power Commission for authority to construct approximately 61 miles of natural gas transmission line in northern and southwestern Ohio in order to meet increased demands and future growth in Sandusky, Elyria, and Dayton market areas.

The proposed $2,690,000 project includes about 16.5 miles of line in Erie County, 23.1 miles in Lorain County, eight miles in Warren and Montgomery Counties, and 13.7 miles in Madison County.

Charles D. Meginnis Dies

Charles D. Meginnis, assistant treasurer of The Philadelphia Gas Works Co., died suddenly on March 16 of heart disease at his home at Ocean City, N. J.

He was born in Philadelphia in 1906, graduated from Northeast High School and from the Wharton School of the University of Pennsylvania. He entered the employ of Philadelphia Gas Works in 1930. He was made assistant treasurer of the company on January 26, 1948.

Raymond H. Arndt

Cameron C. Barr

Operating Personnel Changes Made at Baltimore

Raymond H. Arndt, formerly assistant general superintendent—gas operations, Consolidated Gas Electric Light and Power Co. of Baltimore, has been appointed general superintendent succeeding L. B. Wilson, Jr., who has been retired after thirty-nine years' service with the company.

Mr. Arndt is a graduate of the University of Illinois and did special gas engineering work at Columbia. He began his utility career at the Rockford Gas Light and Coke Co., Rockford, Ill., in 1923. In 1931 he entered the employ of the Baltimore company as assistant to superintendent, gas manufacturing, becoming superintendent in 1938. In 1950 he was made assistant general superintendent of gas operations.

Cameron C. Barr, formerly superintendent, gas and steam distribution, was appointed assistant general superintendent succeeding Mr. Arndt. Mr. Barr was educated at Swarthmore and began his utility career originally with the Harrisburg Gas Co. as a cadet engineer. From 1927 to 1929 he was with the Des Moines Gas Co., Des Moines, Iowa, as a cadet engineer. He entered Consolidated company in 1929 as assistant to general superintendent and was appointed superintendent, gas and steam distribution, in April 1950.

Thomas J. Dwyer, formerly assistant to general superintendent, has been appointed superintendent, gas and steam distribution, succeeding Mr. Barr. Mr. Dwyer is a graduate of Johns Hopkins University and did special work at Drexel Institute. He began his experience in 1923 with the Philadelphia Suburban Counties Gas and Electric Co. as engineering assistant and entered the Consolidated company in 1930 as a technical assistant.

All appointments were effective April 1st.

Norman R. McKee Is President Of James H. Knapp Co.

Norman R. McKee, retired utility executive, has been elected President of the James H. Knapp Co., Los Angeles industrial engineering firm. He succeeds the late James H. Knapp as head of the organization.

Mr. McKee, prior to his retirement last year, was vice-president of Southern Counties Gas Co. He has been a director of the Knapp company for the past 15 years.

L. E. Brown Dies in Peoria After Brief Illness

L. E. Brown, vice-president and general manager of Central Illinois Light Co., Peoria, died recently after a brief illness.

Mr. Brown had been with Central Illinois since 1933. Prior to that time he was associated with Commonwealth & Southern Corp. in an executive engineering capacity, in Jackson, Mich.

After graduation from Kansas University in 1914, he spent two years with the Westinghouse organization in East Pittsburgh. He left that company to take up engineering work with the Eastern Michigan Power Co. following which he served as general superintendent of the Springfield Light, Heat and Power Co. and its successor, Ohio Edison Co.

George E. McCaffrey Is Dead

George E. McCaffrey, superintendent of gas for the Stamford division of the Connecticut Power Co., Stamford, Conn., died on March 24. He was fifty-two years old.

Soon after his graduation from Worcester Polytechnic Institute as a chemical engineer in 1919, Mr. McCaffrey was employed by Stone and Webster of Boston, Massachusetts, as chemist with their Haverhill Gas Light Co. In 1923 he was promoted to chief chemist of the Fall River Gas Works by the Stone and Webster Co. Mr. McCaffrey joined the Connecticut Power Co. as superintendent of gas in 1930.

Natural Gas Operating Revenues Increase, FPC Reports

Operating revenues of natural gas companies reporting to the Federal Power Commission totaled $163,456,268 in January 1951, an increase of 28.6 per cent over the $127,105,709 reported for the same month a year ago.

Gas utility operating income for January 1951 amounted to $31,757,508, up 18.4 per cent from the $26,833,427 reported for January 1950. Net income for the month was $27,277,271 compared to $23,785,095 reported in January 1950.

Gas operating revenue deductions amounted to $131,810,358, an increase of 31.4 per cent. Of this total, operating expenses accounted for $96,396,953, up 27.8 per cent; depreciation for $10,457,010, up 16.9 per cent and taxes for $24,956,395, up 56.3 per cent.

Gas sales to ultimate consumers in January 1951 were 227,345,000,000 cu. ft., an increase of 18.1 per cent over January 1950. Sales to residential consumers increased 26.2 per cent and to commercial and industrial consumers 21.3 per cent and 9.7 per cent, respectively. Revenues from sales to ultimate consumers increased 23.9 per cent and amounted to $85,864,049. Revenues from the three classes of service—residential, commercial and industrial—increased 26.6 per cent, 24.6 per cent and 15.3 per cent, respectively.

For the 12 months ended January 31, 1951, gas operating revenues aggregated $1,343,589,079, an increase of 27.6 per cent over the total of $1,052,857,179 reported for the 12 months ended January 31, 1950. Net income for the period amounted to $184,076,387 compared to $141,990,298 for the previous 12 months, an increase of 29.6 per cent.

Net gas utility plant of the reporting companies aggregated $3,196,505,976 on January 31, 1951, compared to the $2,698,380,820 reported a year earlier.

These data are based on monthly reports filed by 88 natural gas companies, nine more than were represented in previous statements and are thus not strictly comparable with preceding statements in the series.

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Industrial Gas School Ready To Start Classes

The 1951 American Gas Association Industrial Gas School will be held at the Hotel William Penn, Pittsburgh, May 14 to 18, under the sponsorship of the Industrial and Commercial Gas Section. The sales training committee, Terry Hart, chairman, Nashville Gas & Heating Co., is in charge of the school whose purpose is to provide technical training for men who promote or sell gas for the heating operations of industrial processes.

The five-day course will provide instruction in the utilization and sale of industrial gas under the headings of: fundamentals; heavy industrial applications; steam generation and fluid heating; special applications including high speed gas heating, prepared atmospheres and food processing; and industrial sales problems and salesmanship.

A discussion of the principles of the combustion of various fuels, and of the various types of burners and combustion systems used on industrial gas equipment will be led by Jack Huebler, Surface Combustion Corp., and H. F. Rehfeldt, The Peoples Gas Light and Coke Co.

Mathew H. Mawhinney, consultant, will discuss heat balance, heat transfer, furnace and burner capacity in industrial furnaces. Temperature measurement and control will be given by J. L. Garrison, and protective practices will be presented

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Men of wide experience will lecture on the general principles of heat treating and the equipment used for this purpose; the equipment for forging, pressing and extruding metals and alloys; and the design of ovens, the application of air heaters for drying and finishing. Also to be covered will be non-ferrous metal melting and the various types of furnaces to do this job, and the manufacturing operations and problems involved in the uses of gas fuel for ceramic kiln firing and in the manufacture of glass. The lecturers for these subjects will be: Carroll B. Mershon, Continental Equipment Co.; Hale A. Clark of Michigan Consolidated Gas Co.; J. D. Russell, Young Brothers Co.; R. A. Hastings, Continental Industrial Engineers, Inc.; Dr. J. T. Robson, Ferro Enamel Corp.; and Aaron K. Lyle, Hartford-Empire Co.

David M. Barrett, of Washington Gas Light Co., will explain boiler classifications, and A. D. Wilcox, Eclipse Fuel Engineering Co., will talk on commercial boilers used for heating and process steam with recommendations for sizing gas-designed boilers to the job and conversion burners to boilers. Fire tube boilers including package steam generators and a discussion of the more common types of the larger fire tube boilers will be led by A. D. Frydendall, The Peoples Gas Light and Coke Co. A lecture on converting power plant boilers and steam generators above 500 hp will be given by L. S. Reagan, of Webster Engineering Co.

Floyd B. Neyhart, Carrier Corp., will discuss use of gas for air conditioning.

Maurice J. Dewey, Dewey Gas Furnace Co., will lecture on immersion heating, external heating and submerged combustion for water and other solutions.

Industrial gas sales problems will be presented the last day during the morning session. One of these will be the lecture on competitive and standby fuels by Charles C. Eeles, The Ohio Fuel Gas Co. Ralph S. Wenner of the same company will discuss customer relations. Selling aids will be discussed by Herman Koester, Jr., W. Wirt Young & Associates. Milton J. Firey will tell the course how to sell industrial gas.

Something New Has Been Added To Garland Broiler

A new version of the Garland broiler is now in production, Paul Inskeep, commercial sales manager of the Detroit-Michigan Stove Co., has announced.

New features include: 14-inch back flue that provides more effective control of smoke vapors; "floating" grid rods that can expand under intense heat and so prevent warping; newly designed exterior with unbroken front that permits easier, faster cleaning; and deeper oven area.

Heavy ceramic radiants, a Garland feature that has been retained, evenly distribute intense heat from two separately controlled multi-port burners.

T. A. Schlink Elected President Of Central Illinois Light

At a meeting of the board of directors of Central Illinois Light Co. held April 11 J. A. Longley, resigning as President, was elected to the newly created office of chairman of the board, and T. A. Schlink, resigning as vice-president and comptroller, was elected President and general manager.

Three new vice-presidents were elected, namely Roy K. Dallas, George W. Hathaway and Earle D. Edwards. R. N. White, secretary, was also elected comptroller and A. W. Egger, assistant secretary, as assistant comptroller.

C. W. Organ continues as vice-president and division manager in Springfield and T. B. Griffith as treasurer.

L. E. Brown was vice-president and general manager of the company at the time of his death on March 31.

Equitable Authorized to Build Compressor Station in Penna

The Federal Power Commission has authorized Equitable Gas Co., Pittsburgh, to construct and operate a new compressor station and other natural gas facilities in Washington County, Pa.

The estimated $1,055,739 project will include a new compressor station consisting of three gas engine driven 1100 hp units and a dehydration plant.

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Weather Forecasting

(Continued from page 30)

mated system mean. Panhandle Eastern Pipeline Co. operations usually achieve this, and often the variation is less. Since the system mean forecast is total of highs and lows for several points, each degree of variation has its effect. If four points are used, eight temperatures are used in the calculation and one temperature variation means a ⅛ degree error in system mean. Thus, there is little margin for error, and both meteorologists and gas dispatchers maintain close vigilance to detect changes in temperatures.

So long as the hour-to-hour temperatures adhere to the anticipated pattern of a rising temperature from the 7:00 a.m. low to 3:00 p.m., and falling temperature from that hour until the next morning, it is not difficult for a pipe line to meet an estimated line pack at the end of the day. With an accurate forecast and a good diversity factor, the pack can be held close to the estimate.

A company maintaining a high load factor through the ability to increase or decrease gas volume to its interruptible customers has a good deal of flexibility in adjusting to weather changes. A predicted temperature drop requires curtailment of these users; a warm front means that additional gas will be delivered to them. If supply cannot equal house heating demand during severe cold, even after these interruptible users are cut off, the next step is, of course, curtailment of non-interruptible industrial users.

Close range forecasting makes it possible to delay curtailment until the last possible moment. Very often, curtailments which would cause hardship to industrial users can be averted by forecasting.

What happens during unusual weather can be illustrated by two days from this past winter. The Friday Weathercast for Sunday, December 17, gave a pipe line a system mean of 26 degrees, but this was adjusted to 28 degrees by the next day. Then a cold front moved toward the area, and an emergency warning late Saturday night told the dispatchers to expect a system mean of 12 degrees for Sunday. The actual mean was 10 degrees.

The company was already in curtailment, and, since it occurred on a weekend, other demand was low. By correcting scheduling to the 12-degree mean forecast, the company missed its estimate by only 9 million cubic feet.

New Year's Day went the other way. The Sunday morning forecast indicated a 22-degree mean. A revision later called for a 43-degree mean for Monday. The actual mean turned out to be 42 degrees. Curtailment on the first forecast would, of course, have been a serious error.

What are the future refinements required for perfecting further the forecasts on which dispatchers can base their calculations and thus enabling them to increase the accuracy of estimated send-outs?

The answer to such problems as were presented over New Year's Day may be found in even more specialized forecasting. By dividing the gas day into three 8-hour periods, and by taking hour-by-hour forecasts of temperatures for each of those periods, a pipe line could avoid the possible drastic changes in line pack which are necessary occasionally when only the highs and lows at the beginning and end of the gas day are estimated. Smaller adjustments could be made more frequently. Such forecasting can, of course, be provided.

Studies on the effect of wind velocity and cloudiness on gas demand should result in more precise formulae for gas companies. We know that days having wind velocities of Beaufort five or six will show higher gas consumption. A study of a single city, with all demand factors controlled, would reveal a good deal about the effect of wind and clouds. If gas shortages continue and perhaps intensify in defense production areas, such studies would be valuable in narrowing the margin for error in estimat-

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ing send-outs even further than is required today.

Gas companies also put weathercasts to work in other phases of operation. During the past summer, for example, Laclede began installing a new belt line system requiring 22 miles of large steel pipe. November 1 was the target date for completion, and construction was running perilously close as the deadline approached. The final purging operations required clear weather, and weathercasts were utilized in scheduling this operation.

In another instance, a remote control regulator was being installed on the new line, and was not ready soon enough. A forecast indicated expected peak loads on that line, and Laclede sent out crews to operate the control manually.

It is our belief that we are nearer the beginning than the end of discovery of new techniques of meteorology for industrial use, and that specialized weather surveys plus continued experience in predicting demand on the basis of forecasts will further increase the profit for many types of industry now being found in forecasting.

Stevenson Is Elected President Of Gas Construction & Service

Walter W. Stevenson has been elected President of Gas Construction and Service Co., of New York. He takes the place of Harold Moore, who resigned for reasons of health, but remains as a director.

Also associated with Mr. Stevenson in the company are Eric Larson, President of Commonwealth Natural Gas Corp., of Virginia, C. B. Farrell and Harold Wallis.

Gas Construction and Service has converted the following cities to natural gas service within the past nine months: Roanoke, Charlottesville, Portsmouth, Suffolk, in Virginia; Bluefield, West Virginia; and Oneida, N. Y. Columbia, S. C., was converted to hiBtu oil gas.

Crews are now working in the Philadelphia area, and will soon be transferred to New England.

Increase in Capacity Proposed By Central Kentucky

Central Kentucky Natural Gas Co., Charleston, is seeking Federal Power Commission authorization to construct approximately 13 miles of 20-inch pipe line which would make available an additional 52 million cu. ft. of natural gas daily to customers in the Cincinnati area.

The proposed new section of line, estimated to cost $780,000, would loop the company's existing 14-inch line extending northwestward from North Means, Ky. The present capacity of the company's facilities in the Cincinnati area is 247 million cu. ft. per day, and completion of the proposed facilities would increase it to 299.

Uniform Gas Urged

(Continued from page 22)

tunity to establish such a unified policy which, if carried successfully to its objective, would deserve and command the whole-hearted and best efforts of *all* equipment manufacturers. Instead of being kept out of the New England market, because of the expense of numerous special appliances and design features, they could not afford to stay out of what would become the biggest concentrated mass market for uniform gas appliances. Such a policy of gas uniformity would obligate the appliance industry to assistance, to promotion, to development, and I am certain this obligation would be discharged—to everyone's gain.

These challenges, the equipment manufacturers see now and on the horizon of the New England gas expansion program. They involve problems requiring a solution which can well influence and chart the course of gas progress. There exists indeed a triple opportunity for our industry—to help itself, to help the gas equipment manufacturer, and advance the entire national gas industry.

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HiBtu Oil Gas

(Continued from page 26)

these processes the amount of fuel oil used is not too significant since the plants are used only for peak load purposes. Results of operation with various processes using the lighter oils are readily available in the Proceedings of the American Gas Association and in the trade press. A summary of results using the regenerative process was shown in an article by C. E. Utermohle in the *AGA Monthly* for November 1948 below in Tables 2 to 4:

An interesting analysis of the distribution of products between carbon, tar and light oil and gas is shown in Table 5. This table also indicates the distribution of the carbon that may be anticipated in the checkerbrick of the oil gas set. It should be remembered that the carbon from cracking will be rather uniformly distributed through the carburettor and superheater. The carbon from the coke residue (Conradson carbon) in the oil will all be deposited on the surfaces where the oil is vaporized. It is then readily apparent that special means must be provided to burn out the carbon from the initial vaporizing zone when oils with substantial amounts of coke residue are used.

It is interesting to observe from these figures that the total amount of heat used per gallon of oil was substantially the same regardless of the type of oil that was cracked. This might be anticipated since radiation losses and sensible heat losses in the blow and make gases are substantially the same regardless of the oil that is used. It is also interesting to note that better than 200 pounds of carbon per run were deposited in the set under all conditions of operations from 190 gal of 0.2 per cent Conradson carbon to 117 gal of 13.03 per cent Conradson carbon oil per run. It is apparent that unless this carbon is completely removed each cycle, it will gradually accumulate in some inactive part of the set and finally make it necessary to shut the set down for cleaning or surfing.

To summarize then, it will thus be seen that while there may be a best process for any one situation there can be no single process that is best for every situation. The problems of oil selection, cracking pressures and tar and oil handling facilities must be answered for each plant after a thorough study of all the factors that are involved in obtaining the most economical dependable operation at the time desired.

Century Anniversary Celebrated By W. C. Holmes & Co., Eng.

The W. C. Holmes and Co., Ltd., engineers of Huddersfield, England, has recently celebrated its 100 anniversary with the publication of an illustrated book entitled, "The Story of One Hundred Years of Endeavor in the Service of the Gas Industry."

The book, according to D: H. Henshaw, chairman of the board, is a symbol to mark the occasion "when one hundred years have seen the expansion of a small private business into a company whose products are employed throughout the world."

In 1850 the ironworks firm of W. C. Holmes and Co. was founded by William Cartwright Holmes, then only 23 years old. Shortly thereafter the company started to specialize in manufactured gas plants. As early as 1853 W. C. Holmes took out a patent concerning "improvements in the manufacture of gas and apparatus employed therein." With the expansion of the gas industry near the turn of the century, the firm began to specialize in the cooling, washing, purifying, storing, and metering of gas, and later to by-products recovery.

Since 1880 every department and shop has either been rebuilt or extended to several times the original size.

The book also describes the company's war service, employees' loyalty and their working conditions. The firm provides facilities for cricket, tennis, bowling, golf, football, and track.

One chapter of the book is devoted to the town and the townspeople:

"Huddersfield people are proud of their town, of their fame in sports and music and take special pride in their knowledge that the products of their brains and hands are accepted as the standard of first class workmanship in all parts of the world."

Alec Crowell Joins OPS

Alec M. Crowell has taken a leave from Natural Gas Associated Consultants, New Orleans, to become chief of the fuel and chemical section, New Orleans district office of price stabilization.

TABLE 2—TAR ANALYSIS(1)

Conradson carbon content of oil used, %	.20	3.16	6.02	13.03	12.56
Tar analysis:					
Specific gravity	1.159	1.189	1.208	1.214	1.211
Free carbon, CS_2 Extraction, %	9.70	11.92	16.18	15.76	16.78
Free carbon, C_6H_6 Extraction, %	9.66	12.64	16.53	17.18	16.34
Unsulfonated residue					
Up to 300°C, %	1.71	1.33	.63	.68	.45
300° to 355°C, %	.43	.41	.25	.32	.32

TABLE 3—OIL ANALYSIS(1)

Conradson carbon, %	.20	3.16	6.02	13.03
Ash content, %	.02	.01	.04	.16
Enriching value, M Btu per gallons (Dick method) (avg. of (1400, 1500, 1600° F results)	103.6	98.8	102.5	93.8

TABLE 4—OPERATING RESULTS(1)

Btu of gas per cubic foot	1046	1006	1047	966
Specific gravity of gas	.855	.866	.834	.867
Gallons heat oil per Mcf*	.99	.80	.95	.28
Gallons make oil per Mcf*	11.50	11.46	10.67	11.69
Gallons total oil per Mcf*	12.49	12.26	11.62	11.97
Gallons tar per Mcf*	2.56	2.73	2.30	2.63
Gas made per day Mcf*	5,952	5,088	5,088	3,576
Thermal efficiency, %	79.2	80.9	81.8	80.6

* 1,000 Btu basis.

(1) C. E. Utermohle, "AGA Monthly," November 1948.

TABLE 5—ANALYSIS OF HIGH BTU GAS PROCESS

Yield, pounds per gallon oil				
Conradson carbon in oil, %	.20	3.16	6.02	13.03
Pounds carbon from Conradson carbon	.015	.25	.46	1.05
Pounds Carbon from Cracking*	1.16	1.16	.86	.80
Pounds tar and light oil	2.105	2.34	2.15	2.25
Pounds gas	4.03	4.13	4.21	4.00
	7.310	7.88	7.68	8.10
Fuel used, per gallon of oil cracked				
Deposited carbon, lbs.	1.175	1.41	1.32	1.85
Heat oil, gallons	.085	.07	.09	.023
Btu used per gallon of oil cracked				
from carbon	16,550	20,200	19,150	26,200
from heat oil	12,400	10,100	12,800	3,400
Total	29,950	30,300	31,950	29,600
Make oil per run, gallons	190	161	146	117
Carbon in vaporizer, lb. per run	3.0	40.0	87.0	123.0
Carbon in cracking chamber, lb. per run	221.0	187.0	126.0	94.0
Total carbon in set, lb. per run	224.0	227.0	213.0	217.0
Tar analysis				
% Free carbon, C_6H_6 extraction	9.66	12.64	16.53	17.18
Specific gravity	1.159	1.189	1.208	1.214

* By difference, pounds oil less other products

CONVENTION CALENDAR

May

14-16 AGA Production and Chemical Conference, Hotel New Yorker, New York.
15-17 Pennsylvania Gas Association, Wernersville, Pa.
17-19 Public Utilities Advertising Association Convention, Hotel New Yorker, New York.
21-23 Missouri Association of Public Utilities, annual convention, Jefferson Hotel, St. Louis.
27-30 American Society of Refrigeration Engineers, Spring Meeting, Hotel Statler, Detroit.

June

18-21 Canadian Gas Association, Bigwin, Lake of Bays, Ontario.
25-26 Michigan Gas Association, The Grand Hotel, Mackinac Island.

September

4-6 PCGA Convention, Fairmont Hotel, San Francisco.

October

15-17 AGA Annual Convention, St. Louis.

AGA Washington Office

The American Gas Association has opened an office in Room 603, Albee building, 1426 G Street, N. W., Washington. Assistant Managing Director George H. Smith is in charge. It is planned that, after May 15, Mr. Smith will be permanently assigned to Washington to render all assistance possible to the gas industry in its relations with the federal government.

Changeover Practices

(Continued from page 40)

Job specifications should definitely prohibit conversion men from doing anything on oven heat controls except by pass and oven pilot adjustment. Anything else is repair, not conversion, and should be handled by the company and not the contractor.

Combination ranges—

This is a headache category, always has been and, in a conversion, will become more so. A great many of them are not AGA approved, but have filtered into your territory without your knowledge or approval but, nevertheless, you must do something with them.

The main fault with them is lack of secondary air to oven burners. This can often be overcome by drilling additional air holes but, where construction details make this impossible or impractical, undergassing is the only alternative.

Before leaving the subject of the range may we repeat the former statement that the cooking load is your most important load, and that it would be almost impossible for you to be too exacting in your specifications and in your work quality control on this appliance.

Consider very carefully the question of whether or not you should specify pilot filters as part of the conversion. If you decide in the affirmative you are spending a large sum of money. If you decide against them you may be borrowing untold trouble and future expense. This is one subject that the contractor cannot help you decide.

The company plant men, distribution men and customers' service men should discuss this question jointly, since the type and purity of gas made, the internal cleanliness of the distribution system, the delicacy of appliance pilot operation, whether you intend to humidify and/or oil fog, whether the humidification is to be by wet holder or steam nozzle, whether oil fogging is to be hot or cold, should be considered in the final disposition of this question.

Refrigerators

The very minimum conversion on this appliance should include removal of the old burner, cleaning of the generator flue, installation of the new burner on a properly adjusted burner bracket in such a way that the burner head is slightly below the center of the generator flue to allow for the natural tendency of the tip of the flame to curl up, the selection of the proper orifice for the particular refrigerator, the maximum and minimum input setting by manometer and final primary air adjustment.

The best conversion of this appliance would also include, in addition to the

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- *Our trained crews* are ready for immediate service when natural gas reaches New England.
- *Our trained crews* are also thoroughly experienced in conversions from manufactured gas to high Btu oil gas.

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foregoing, the removal of the refrigerator from the wall, the cleaning and possible replacement of corroded parts of the remainder of the flue system.

A number of years ago the manufacturer of gas refrigerators used a generator flue baffle which was inserted from the front and was locked in place by means of a wire protruding from the front of the generator flue and attached by means of a screw to the front of the unit.

These wires tend to bend from heat in the flue and, by so doing, interfere with proper combustion. Eventually these same wires burn off, leaving the baffle without proper anchorage.

Where this condition is encountered you should either replace the wire or replace the baffle with the proper current model which is inserted and locked from the back. To replace the baffle is expensive, since the refrigerator must be moved out. To replace the wire will require making new wires locally as the manufacturer no longer supplies this obsolete item.

Water Heaters

The majority of tank water heaters are similarly constructed and therefore a very general conversion procedure is satisfactory. In some instances they are equipped with name plates specifying the Btu rating, but in many instances this is not true. As a result, it is necessary on the ones with no input ratings, to divide all heaters into three general categories—small, medium and large—and decide what input you consider correct in each case. In those cases where the Btu input is specified on the name plate and the heater is found to be vented, it is quite satisfactory to place the full Btu input on the heater. It is generally considered advisable to under-gas all tank water heaters which are unvented by about 15 per cent. It will be necessary to enlarge the port area in every instance. This does not create a problem to any great extent, since practically all tank water heater burners are of the raised drill port type. It is felt that the orifices in every instance should be made of the fixed type in order to insure a proper rating on the heater which is not easily altered by tampering. It will be found that the use of a tool especially designed for insertion from the top of the venturi tube to fit on the orifice spud will be very beneficial, in that it will make it possible for the changing of the orifice spud without the necessity of disconnecting or removing the venturi from the heater.

Automatic water heaters present more of a problem in conversion since they consist not only of a main burner but a safety pilot, and in some instances a by-pass or throttling adjustment. The conversion man should be instructed to make no adjustments whatever to the thermostat unless it is of a throttling type, in which case the bypass must be adjusted. In those cases where snap action thermostats are installed, the general practice on the part of conversion men is to bring the heater on and off by use of the lever adjustment arm of the thermostat. One of the main complaints resulting from conversion is usually insufficient hot water which, in many instances, is found to be caused by the converter leaving this arm at a setting lower than that to which the customer is accustomed. They should be cautioned in this respect to, in some way, mark the thermostat body so as to get this pointer back to the same position after conversion. All orifices should be of a fixed type in order to insure correct rating. All the raised drill port burners are handled in the same manner as tank water heaters, in that they are drilled to increase this port area. Spacer type burners are converted by replacing the spacers. Ribbon type burners are replaced in their entirety. Slotted burners should be thoroughly cleaned, after which they will be found to burn correctly with the new gas. All venturi throats should be examined and thoroughly cleaned of any foreign matter to insure proper air inspira-

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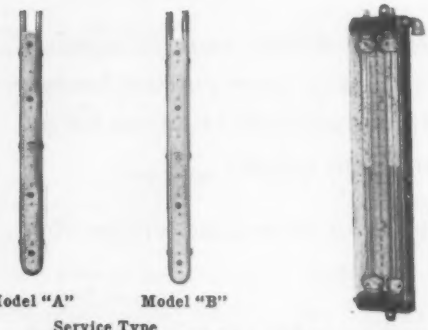

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tion. Pilot orifices should always be replaced rather than adapted. Generally speaking, it will be found that luminous flame pilots should be converted to Bunsen pilots.

The instantaneous water heater is rapidly becoming extinct on gas lines. However, there are still quite a few of them connected and therefore must be considered. The majority of these heaters are equipped with gauze type burners, and in practically all cases, it is necessary to replace or clean the gauzes in the burner to obtain proper flame characteristics. All orifices should be of the fixed type to insure correct rating. Luminous flame pilots, as in the case of automatic water heaters, should be converted to Bunsen pilots.

Commercial and Industrial Equipment

Volumes could be written on this subject because of the multiplicity of appliance types, applications and operating conditions, but the same basic problems pertain to all equipment of this nature to a greater degree than in the case of domestic appliances.

Things to remember are—

Natural gas and air produce a larger, lower temperature flame than manufactured gas and air.

Natural gas and oxygen produce a shorter, higher temperature flame than manufactured gas and oxygen.

Natural gas cannot be burned in as confined a space as can manufactured gas.

Operations which have been taking advantage of the short, hard flame possible with manufactured gas and atmospheric air may, after conversion, require pressure air.

House Heating Conversions

Since house heating equipment cannot be shut off for any appreciable length of time during the heating season, it is desirable when planning a change over to have it carried out either when heating is not required at all or when burners can be shut off for several hours without discomfort to the customer. If the change over can be done during the season when house heating is normally shut off, the hazards of burners going out by lifting off the ports or of badly carboning heating surfaces are eliminated. Added to this is the advantage of being able to work on the burner without waiting for the equipment to cool off. Thus the seasonal nature of the house heating load has advantages if the change over can be done during the summer, but it also has a disadvantage if the change over must be done during the heating season since the equipment *must* remain in use in a safe and efficient condition or much damage can be done.

Since the same Btu input is required to operate the heating system satisfactorily, then the conversion of the burner requires the same operations as any other gas burner, that is, increasing the port area, decreasing the orifice size and adjusting the primary air. However, due to the great variety of burners in use, it is possible only to discuss them here in general terms. Some types of burners cannot be converted at all, others only at considerable expense, and the remainder quite simply and economically. The ribbon type burner is one of those which, due to fixed port area, is virtually impossible to convert at its rating. Jet type burners with their fixed gas-primary air ratios will probably not operate satisfactorily, but can be converted by changing the jets. The drilled port type of burner with adjustable primary air and replaceable or adjustable orifice can usually be converted quite simply. Some of these burners have detachable venturi tubes which may be changed to get sufficient primary air if found necessary.

In converting conversion burners to the rating used on manufactured gas, it is necessary to determine what that rating was. If a survey is being made prior to the change over, the rating may be determined then by meter timing, and the conversion crews supplied with charts showing comparable CFH for the new gas (Table 1), which can then be set by meter timing. If the orifices are of

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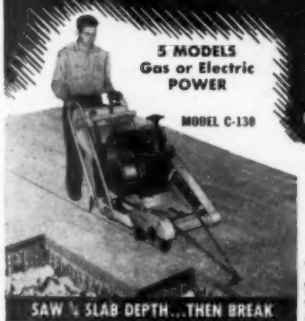

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fixed size but are replaceable or adapters can be used, a table such as 2 can be developed for the new gas and used by the conversion crews. Another method of obtaining comparable inputs where fixed orifices are used is by installing orifices of a size determined from the size of the old orifice. (Table 3.)

In most cases the port area must be increased by drilling the ports. The maximum input per sq. in. of port area is determined by the lifting limit, which is dependent on the ratio of the speed of flame propagation to the velocity of the gas air mixture leaving the port. The speed of flame propagation is a function of the constituents of the mixture and for any given input to the burner, the velocity of the air-gas mixture depends on the area of the ports and the percentage of primary air in the mixture. Thus it is a matter of either drilling the ports or decreasing the percentage of primary air to prevent lifting. There is also a relation between the maximum Btu/hr./sq.in. of the port area and the ratio of throat to port area. By increasing the ratio of throat to port area, the number of Btu per square inch of port area can be increased. Where ever changes in percentage of primary air are involved and secondary air is controlled, alterations must be made in the amount of secondary air. To insure proper burner efficiency CO_2 tests of the flue gases will aid in the correct settings of the new air adjustments.

Pilots for house heating equipment should be given considerable care at the time of conversion to prevent future service calls. In many cases they can be replaced as economically as they can be modified. Their location may have to be changed to allow for the different ignition characteristics of the new gas although this is not generally necessary.

If at all possible tests of representative burners should be conducted to determine their adaptability to the new gas and the nature of the modifications to be made. If this is done considerable inconvenience and embarrassment may be avoided later.

The actual conversion of oil burner pilots is not difficult. The trouble lies in the high bill complaints that these pilots cause.

There are three popular types of oil burner pilots—

1. Continuous—This pilot burns constantly at one size.

2. Expansion—The small continuous pilot enlarges for a pre-set time interval for each burner operation.

3. Gas-electric—This pilot is ignited by a spark plug and only burns for a pre-set time interval for each burner operation.

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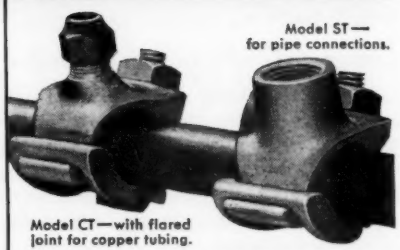

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Participation by the individual in a conversion broadens his outlook on, and his understanding of the industry. Without question, it makes him what we all want to be, a better gas man.

Insulated Meter Nut Introduced By Universal Controls

An insulated meter nut has recently been introduced by Universal Controls Corp., Dallas.

A molded nylon plastic liner in which the threads are machine cut provides cathodic protection by breaking all metal-to-metal contact between the inlet pipe and the meter. It can also be used on farm tap lines connected with cross-country pipe systems.

The nut offers protection against stray electric currents from grounding telephones, radios, and other equipment which may be linked to water or gas lines in the house.

A swivel which retains the lower pilot extension may be used with the nut if a ¼-inch rubber gasket is set in place to break all metal-to-metal contact.

The nut is machined for each type of meter and electrolytically zinc plated to prevent rusting.

Work Starting on Super Inch Booster Plants

Construction forces are beginning preliminary work on the Topock and Hinkley compressor stations of Pacific Gas and Electric Company's new Super Inch natural gas pipe line, and installation of a third station at Kettleman Hills will begin soon, the company has announced.

The three plants, costing a total of $12,000,000, will enable P G and E to increase the pipe line's transmission capacity from its present 200,000,000 cu. ft. per day of Texas and New Mexico gas to 400,000,000 cu. ft. per day next fall.

Details of the installations are as follows:

Topock: Six compressors with a total capacity of 15,000 horsepower will be installed in a main compressor building 183 ft. by 50 ft. in dimension. Like the "biggest ever built" equipment used in construction of the Super Inch, the gas engine compressors are the most powerful made for pipe line booster service. Each machine is 32 feet long, stands 14 feet high and weighs 116 tons.

Hinkley: An 8½-acre site has been laid out eight miles west of Barstow and grading is in progress. Largest of the three, the station will have seven compressors like those at Topock with a total capacity of 17,500 horsepower. The main compressor building will be 223 feet long and 50 feet wide.

Kettleman Hills: A three-man team is making a preliminary survey of the site, which will be adjacent to P G and E's existing Kettleman Hills compressor station. The installation will consist of eight compressors, slightly smaller than those at Topock and Hinkley, with a combined capacity of 12,320 horsepower.

Cooling towers, water treatment plants, oil storage facilities, warehouses, garages, shops and offices at each of the three stations will add to the size of the installations. The plants are being built by the Bechtel Corp., a partner in the three-company contracting organization which built the 502-mile Super Inch.

The gas received at Topock now takes approximately 2½ days to reach the San Francisco Bay area. Next fall, at full line capacity, the gas will travel the distance in slightly more than a day.

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New England Gas Properties

(Continued from page 19)

Gloucester, Mass., is No. 1 Fisherman's Headquarters and boasts of an artist colony. In 1951 gas sales were 170 MMcf of 537 Btu gas. Estimates for the fifth year of natural gas operation at 1000 Btu are 365 MMcf.

Lawrence Gas & Electric Co., serving a textile city, had sales of 918 MMcf of 535 Btu gas in 1950, and reports expected requirements of 1,834 MMcf of 1000 Btu natural gas five years hence.

Long Range Planning

The response to the JOURNAL questionnaire indicates that New England gas utilities have for many months been actively working on plans to receive natural gas and use it "in the public service."

The following reply, from New England Electric System, which has 15 gas companies in New England, is representative:

"Plans are being made and materials ordered to convert the present water gas plants at Malden, Lawrence, Salem, Webster, Northampton and North Adams to produce hiBtu oil gas using light oil. This gas will be used for peak shaving or for backup in case of possible failure of the natural gas supply. In addition to the hiBtu oil gas the companies are planning to expand present LP gas plants or to install new ones to supplement their manufacturing capacity. Companies with relatively small production plants and companies which purchase their manufactured gas requirements intend to install LP plants for their peak shaving and backup, and to shut down and abandon their present water gas plants.

"All present storage holders will be retained initially.

"New England Electric System companies expect to odorize the gas at each delivery point.

"Fogging of the distribution systems is planned to start approximately three months ahead of the arrival of natural gas in each company, generally, both hot fogging with oil, and steam humidifying will be used at the present plants supplemented by cold fogging beyond certain district regulators."

An Interesting Comment

Connecticut Light and Power has stated:

"It is estimated that expenditures for expansion of gas storage and production equipment, for the five year period 1952-1956, under present methods of operation would be $1,956,000. With the use of natural gas, along with greater increase in sales, this increase in investment may be held to $1,386,000."

Cities not included in the table on pages 20 and 21 are:

Pittsfield, Taunton, Fall River and Milford, Mass.; Pawtucket and vicinity, R. I.; New London, Conn. and two electric companies in Massachusetts with only 10,000 gas customers.

INDEX TO ADVERTISERS

American Meter Co.	37
Black, Malcolm W. & Co. Inc.	48
Blaw-Knox Div.	15
Bryant Heater Div.	5
Buell Engineering Co.	8
Cast Iron Pipe Research Association, The	6-7
Chaplin-Fulton Mfg. Co.	16
Cleveland Trencher Co., The	49
Clipper Mfg. Co., The	53
Commonwealth Services, Inc.	45
Connolly Inc.	52
Cooper-Bessemer Corp., The	10
Cruse-Kemper Co.	55
Detroit-Michigan Stove Co.	4
Ebasco Services Inc.	43
Empire Stove Co.	39
Fisher Governor Co.	2
Gas Construction and Service Co., Inc.	51
Gas Machinery Co., The	13
Gas Purifying Materials Co. Inc.	46
General American Transportation Corp.	Inside Back Cover
Koppers Co., Inc., Engin. & Const. Div.	1
Lancaster Meter Parts Co.	47
Lattner Mfg. Co. P. M.	56
Norwalk Valve Co.	52
Pollard Co., Joseph G.	53
Reynolds Gas Regulator Co.	Front Cover
Rockwell Manufacturing Co.	Inside Front Cover 28-29
Roper Corp., Geo. D.	41
Safety Gas Main Stopper Co.	56
Selas Corp. of America	14
Semet Solvay Engineering Division, Allied Chem. & Dye Corp.	9
Servel Inc.	12
Skinner Co., M. B.	54
Sprague Meter Co.	Back Cover
Stewart-Warner Corp.	54
Thomas, H. Emerson & Assoc.	46
Vulcan Rubber Products Inc.	11

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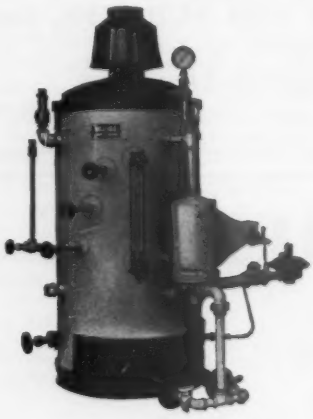

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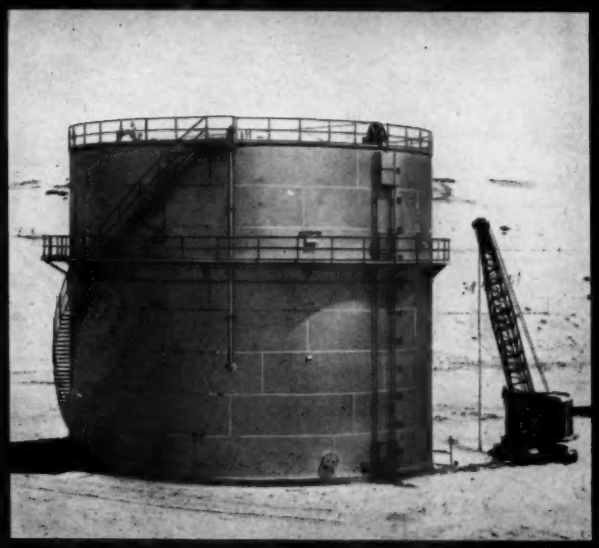

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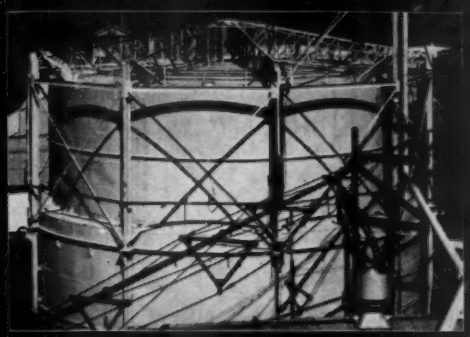

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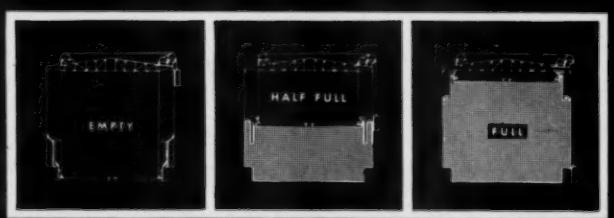

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